ABSTRACTS OF NORTH AMERICAN GEOLOGY

INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts have been prepared only of material that is believed to be generally available.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey. Washington, D.C. 20242. Serial publications cited for the first time are as follows:

Geocom Bull.—Geocom Bulletin. Geosystems, London, England and Calgary, Canada.

Geo. Soc. Denmark Bull.—Bulletin of the Geological Society of Denmark. (English edition of Meddelelser fra Dansk Geologisk Forening). Copenhagen, Denmark.

Jour. Internat. Assoc. Math. Geology—Journal of the International Association for Mathematical Geology. Plenum Publishing Corporation, New York, New York and Plenum Press, London, England.

Louisiana Dept. Public Works Basic Records Rept.—Louisiana Department of Public Works Basic Records Report. Baton Rouge, La.

Oklahoma Underground—Oklahoma Underground. National Speleological Society. Central Oklahoma Grotto. Oklahoma City, Okla.

Soc. Sci. Fennica Commentationes Biol.—Societas Scientiarum Fennica Commentationes Biologicae. Helsinki, Finland.

Utah Dept. Nat. Resources Water Circ.—Utah Department of Natural Resources Water Circular. Salt Lake City, Utah.

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ABSTRACTS

08211 **Aamot, Haldor W. C.** Self-contained thermal probes for remote measurements within an ice sheet, *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 63-68, illus., 1970.

Thermal probes can now penetrate polar ice sheets to depths of 3000 m for measurement of *in situ* temperature and stress conditions. The vertical course is stabilized by mercury or pendulum steering. Power for penetration, and for lateral transfer to avoid premature hole closure, depending on probe speed and ice temperature, can vary from 5 to 15 kW. The sealed confinement in ice, low temperatures, and high pressures present special design problems. First results [1966] from a probe into the Greenland ice sheet at Camp Century gave a hyperbolic cooling curve approaching finally to within 0.1°C after about six days, and indicating a peak crystallization stress in the confined melt water during refreezing of about 88 bar above overburden stress. Two probes reached 230 and 1000 m at Station Jarl Joset. With suitable adaptations, ice movements may be observed, and seismic ultrasonic, and electromagnetic transmission studies are possible. — GDC

Abakumov, O. N. *See* Solopov, S. G. 08256

00880 **Abdel-Khalek, M. Lofti; Khoury, S. G.** Structural and metamorphic evolution of the Otter River area, west-central Piedmont, Virginia: Geol. Soc. America Bull., v. 82, no. 3, p. 707-716, illus., geol. map, 1971.

Rocks of the area consist mainly of ottrelite-graphite phyllites, micaceous schists, micaceous gneisses, hornblende gneisses, and a highly schistose zone of chlorite-tremolite schist. The structural deformation occurred as follows: an early phase of flow folding with the formation of lineation and dominant foliation; a mid-phase of flexural folding of these structures and development of new cleavage and crenulation lineation; a late phase of concentric folds that deformed, but did not alter appreciably the general orientation of earlier foliation. Gradual increase in metamorphic grade across the area is due to the progressive metamorphism of a supracrustal assemblage, initiated during the flow folding phase, and with its intensity related to the level in the crust at which it took place. — RAL

Abrams, M. J. *See* Kamb, Barclay. 00612

08286 **Acad. Ciencias de Cuba; Acad. Ciencias URSS.** Atlas nacional de Cuba [National atlas of Cuba]: Havana, Cuba, Acad. Ciencias de Cuba, 132 p., illus., 1970.

The National Atlas of Cuba, a joint project of the geographic institutes of Cuba and the U.S.S.R., includes maps of the country as a whole at a scale of 1:1,500,000, some with texts, covering geology, mineral deposits, hydrogeology, geomorphology, karst, soils and hydrography. Tectonics, seismicity, geomorphological regions, slopes, coasts and soil regions are mapped at 1:2,500,000, tectonic structures and magnetic declination at 1:5,000,000, and earthquake epicenters at 1:7,500,000. Eight paleogeographic maps at 1:10,000,000 are included. — EH

Acad. Ciencias URSS. *See* Acad. Ciencias de Cuba. 08286

00868 **Achauer, C. W.** Reply [to discussion by John M. Cys, 1971, of "Origin of the Capitan Formation, Guadalupe Mountains, New Mexico and Texas," 1970]: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 313-315, illus., 1971.

Cys' discussion (ibid., p. 310-312) does not present any new evidence in support of a reef origin for the Capitan Formation. In this reply the relation between topography and facies, the recognition of reef massive (core) and reef talus, and the basinward distribution of sponge-algal limestone facies are discussed. For original paper, *see* ibid., v. 53, no. 11, p. 2314-2323, 1969; Abs. North American Geology, May 1970. — SEF

00838 **Ackermann, Norbert L.; Chang, Y. Y.** Salt water interface during ground-water pumping: Am. Soc. Civil Engineers Proc., v. 97, paper 7920, Jour. Hydraulics Div., no. HY2, p. 223-232, illus., table, 1971.

Water, flooded over the ground surface of a salt water saturated medium, drains into the ground forming a fresh-water zone above the salt water which it displaces. By pumping fresh water from drains spaced at periodic intervals in the fresh water zone, the depth to the saltwater-freshwater interface can be controlled. An analysis is made relating the equilibrium position of the two fluid inferfaces to the pumping rate, physical properties of the fluids and porous media, the geometry describing the drain location, and the heads of fresh and salt water. An electric analog model is constructed to check the validity of the theoretical analysis. — Authors' abstract

08327 **Addicott, W. O.** Latitudinal gradients in Tertiary molluscan faunas of the Pacific coast: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 8, no. 4, p. 287-312, illus., tables, 1970.

The Tertiary molluscan faunas of middle latitudes of the marginal eastern North Pacific are characterized by warm-water taxa whose descendents now live more in southerly latitudes. A series of profiles in which cumulative percentages of warm-water faunal elements are plotted against latitude show progressive northward decreases in the percentage of these elements in the faunas of Pacific coast Tertiary stages. Systematic changes in the relative position of these latitudinal gradients during the Middle and Late Tertiary are related to climatic change in the Pacific basin. — *from* Author's abstract

08196 **Adler, H. H.** Interpretation of colour relations in sandstone as a guide to uranium exploration and ore genesis, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 331-344, incl. discussion, illus., table, 1970.

Most uranium mined in the United States occurs in red or drab sandstone, associated with a pyritiferous carbonaceous facies. Many deposits, especially the roll-type, formed by accretion along oxidized borders of reduzate facies. Ore accumulated by recyclic oxidation-reduction and solution-deposition. Deposits are closely related to hematite-red and limonite-drab coloring in sandstone. This post-diagenetic pigmentation is related to geologically recent ground-water circulation and results from release of iron during oxidation of pyrite. Limonite is formed first but may dehydrate to hematite; transformation is accelerated under warm climatic conditions, when ground water may be slightly warmer. If iron is taken up by montmorillonite or removed by ground water, a pale green or bleached color may result. Color can be used to determine extent of oxidative alteration and areas favorable for exploration. — *from* Author's abstract

08321 **AEC Grand Junction Office.** Preliminary reconnaissance for uranium in New Mexico, 1950 to 1958: Washington, D.C., U.S. Atomic Energy Comm., RME-160, 221 p., illus., 1970.

Preliminary reconnaissance reports (1 to 2 pages each) on uranium deposits examined in 26 counties in New Mexico are given. Reports are in outline form and include name of examiner and date examined, name and location of deposit, type of examination, directions to deposit, owner or operator, mine or property history, radioactivity, and very brief description of topography, geology, and mineralogy of each deposit. — VSN

08334 **Ahrens, L. H.** The composition of stony meteorites — [Pt.] 9, Abundance trends of the refractory elements in chondrites, basaltic achondrites, and Apollo 11 fines: Earth and Planetary Sci. Letters, v. 10, no. 1, p. 1-6, illus., tables, 1970.

This paper is in three parts (i) a *critical* examination of the Ca/Al ratio in chondrites. The weight ratio (Ave. = 1.08) is remarkably uniform as indicated in previous work, and is much greater than that in plagioclase (maximum = 0.74). No Ca-Al mineral known to the writer has the chondrite ratio; (ii) a *general* examination of the enrichment trends of refractory elements (Ca and Al excepted) in the sequence: chondrites, eucrites Stannern and/or Nuevo Laredo, Sea of Tranquillity fines; and (iii) the arrangement, on a tentative basis, of various chondrites and basaltic achondrites in a sequence according to their refractory element content. — Author's summary

Aitken, J. D. *See* Cook, D. G. 00943

Alexander, Charles S. *See* Price, Larry W. 00844

00840 **Alford, John J.** A geographic appraisal of Pleistocene overkill in North America: Assoc. Am. Geographers Proc., v. 3, p. 10-14, illus., table, 1971.

At the close of the Pleistocene Period many species of large animals became extinct. In North America radiocarbon dates indicate that the wave of extinctions took place shortly after the arrival of a specialized hunting people. This chronology has convinced some investigators that man was the primary cause for extinction. An examination of the terminal dates for the North American elephants indicates a pattern of extinction contradictory to this view. — Author's abstract

Alfven, Hannes. *See* Arrhenius, Gustaf. 00900

00608 **Allen, C. R.; Engen, G. R.; Hanks, T. C.; Nordquist, J. M.; Thatcher, W. R.** Main shock and larger aftershocks of the San Fernando earthquake, February 9 through March 1, 1971, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 17-20, illus., tables, 1971.

Seismologic information on the main shock of the San Fernando earthquake and its aftershocks through March 1, 1971, is summarized. The main shock has been assigned tentatively the following parameters: M = 6.6; location, 34° 24.0′ N., 118° 23.7′ W.; depth 13.0 km. Breaking apparently propagated southward at about 45°, reaching the surface in the Sylmar-San Fernando region where principal damage occurred. Locations and time of occurrence of aftershocks of M ≥ 3.0 and P-wave arrival times for the main shock are tabulated. Epicenters of aftershocks tend to delineate boundaries of the thrust displacement, although many of the shocks on the western limb evidently represent deeper strike-slip events with a very complex relation to the main thrust fault. — VSN

Allen, Clarence. *See* Moran, D. F. 00635

Allen, D. R. *See* Mayuga, M. N. 00806

00814 **Allen, D. R.; Mayuga, M. N.** The mechanics of compaction and rebound, Wilmington Oil Field, Long Beach, California, U.S.A. [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 410-423, illus. [1971].

Subsidence of the ground surface above the center of oil production, about 9 m in 27 years, is attributed to compaction in oil reservoirs caused by fluid and pore pressure reduction. Axial loading tests on reservoir sands and shales show that sands are as compactable as shales or more so. Reservoir calculations, oil-well casing measurements, and laboratory tests indicate a reduction of 3 to 4 percent in bulk sand volumes (about 10-11 percent of pore volume). Most compaction prior to 1952 occurred in reservoir sands; 32.4 percent of cumulative compaction occurred in shales and 67.6 percent in sands. Water injection programs arrested subsidence and caused elastic rebound, which in conjunction with pump pressures, uplifted the surface 33.5 cm over 8 years. Rebound may be confined principally to sand intervals. The coefficient of rebound is estimated at .005 per unit of vertical sand thickness of which about 50 percent is seen at the surface due to unrelieved stresses in the overburden. — *from* Authors' abstract

08320 **Allen, John R.** Physical processes of sedimentation: New York, American Elsevier Publishing Company, 248 p., illus., tables, 1970.

This textbook is designed for the undergraduates in the second or third year of geology and to postgraduates beginning research in the field of sedimentology. It is concerned with the physical background to formation of terrigenous clastic deposits, and the way in which properties of these deposits depend on the character and magnitude of relevant physical processes. The seven chapters of the text are: physical background to sedimentation; some sedimentary structures, and a note on texture and fabric; winds and their deposits; river flow and alluvium; waves, tides, and oceanic circulations — shallow-marine deposits; turbidity currents and turbidites; and glaciers and glacial deposits. — VSN

00761 **Allen, William H., Jr.; Goettsch, Betty C.; Kennedy, Robert K.** Surficial geology, soils, and plant zonation, Ross biological area: Iowa Acad. Sci. Proc. 1970, v. 77, p. 233-248, illus., tables, 1971.

The study area, a nearly square tract of 69,684 sq ft, one mile northwest of Ames, Iowa, is a continuous landform from the top of a hill down the backslope, with a bench terrace and alluvial fan midway, and onto a former meander channel of ancestral Onion Creek. The backslope is mantled by till of Cary age, with underlying loess (not exposed), and the valley is filled with alluvium. The soil toposequence, from the summit downslope, consists of Clarion, Storden, Terril, Colo, and Spillville series, which reflect environmental and erosional influences as well as the geologic parent material. Of 104 plant species identified, 45 could be used as indicators for plant zonation; both herbaceous and woody species are closely correlated with soil type and soil moisture regimes. Soil study serves as the link between ecologic and geomorphologic studies where both are concerned with developmental history. — VMJ

Anderson, D. H. *See* Ingamells, C. O. 00846

Anderson, Don L. *See* Jungels, Pierre. 00614

Anderson, Don L. *See* Davies, Geoffrey F. 00832

00752 **Anderson, Orson L.** Reply [to discussion by H. Mizutani of "Elastic constants of the central force model for three cubic structures — Pressure derivatives and equations of state," 1970]: Jour. Geophys. Research, v. 76, no. 11, p. 2797, 1971.

The paper under discussion was published in Jour. Geophys. Research, v. 75, no. 4, p. 2719-2740, 1970; *see* Abs. North American Geology, this issue.

08425 **Anderson, Orson L.** Elastic constants of the central force model for three cubic structures — Pressure derivatives and equations of state: Jour. Geophys. Research, v. 75, no. 14, p. 2719-2740, illus., tables, 1970.

The case of the generalized repulsive potential in the central force approximation is used in Born's lattice theory to derive the elastic constants versus pressure for the NaCl, CsCl, and ZnS structures. The equations are rearranged so that c_{ij} is a function of K and P, the bulk modulus and pressure. The isothermal equation of state relates K, P, and the density ρ, so that the elastic constants are specific functions of the relation between K and P, and ρ and P. As a special case of the theory, the parameter in the repulsive potential n is evaluated by the measured value K'_o. The theory shows that the simple repulsion $v(r) = b/r^n$ accounts for the experimental results, except for a small term due to noncentral binding. — Author's abstract

08366 **Anderson, Peter W.** Occurrence and distribution of trace elements in New Jersey streams: New Jersey Div. Water Policy and Supply Water-Resources Circ., no. 24, 24 p., illus., tables, 1970.

The concentration of trace elements was measured in water samples collected at 37 stream-sampling sites in New Jersey. Data indicate prevalence of higher concentra-

tions than normal in some streams. Such concentrations generally are found only in streams where water quality is greatly influenced by discharge of industrial and municipal waste waters. High concentrations of Fe and Mn relate better to vegetal decomposition or ground-water inflow to streams. The magnitude of concentration of individual elements in descending order is: Fe, Al, Sr, Mn, B, Ba, Cr, Cu, Ni, Zn, Pb, Co, Li, Ti, Rb, V, Mo, and Ag; Be, Bi, Cd, Ge, and Sn were not observed. — *from* Author's abstract

08383 **Anderson, V. H.** Sea ice pressure ridge study — An airphoto analysis: Photogrammetria, v. 26, no. 5-6, p. 201-228, illus., 1970.

Tested and proven techniques of terrain analysis using conventional aerial photography were applied to interpret the patterns associated with a sea ice environment [arctic Alaska]. Ages and relative thicknesses of sea ice masses were determined from stereoscopic aerial photography. A classification scheme of sea ice pressure ridges is developed based upon their linear surface trace, their relative ages, their heights, widths and lengths, their location relative to recent ice movement, and the size of the material composing the ridges. The significance of sinuous ridges with respect to straight ridges is discussed relative to the forces involved in their formation. Estimates as to the underwater components of pressure ridges are deduced based upon elements of their surface configuration and pattern. — Author's abstract

00829 **Andrews, J. T.; Estabrook, G.** Applications of information and graph theory to multivariate geomorphological analyses: Jour. Geology, v. 79, no. 2, p. 207-221, illus., tables, 1971.

Information- and graph-theory methods for examining the interrelationships among variables and among individual objects use nominal scale data. Their use is illustrated by a 41 (objects) × 12 (variables) matrix relating to the cross-valley moraines of Baffin Island. The variables measure such factors as moraine shape, location, till fabric, and clast roundness. The information-theoretic approach generates a measure of distance (D) and computes the amount of shared information between the variables. Unconditional and conditional probability tables are used to assess the stochastic dependence among states of two variables. Graph-theoretic methods are used to develop a measure of similarity that is used in a classification of the moraines. Since the techniques use nominal data, they should have general application in many fields of geology. — *from* Authors' abstract

08284 **Appleman, Philip.** (editor). Darwin, a Norton critical edition: New York, W. W. Norton and Company, 674 p., illus., 1970.

This collection of excerpts from primary material and selected scholarly commentary is designed to demonstrate some of the ways in which Darwin's work exercised an influence on the intellectual history and day-to-day life of modern man. The text is in seven parts as follows: scientific opinion in the early nineteenth century, a selection of Darwin's work; Darwin's influence on science, Darwin's influence on theological and philosophic thought, Darwin and society, Darwin and the literary mind, and epilogue. — VSN

Armstrong, E. F. *See* Egbert, R. L. 08153

00938 **Armstrong, Richard Lee.** Glacial erosion and the variable isotopic composition of strontium in sea water: Nature Phys. Sci., v. 230, no. 14, p. 132-133, illus., 1971.

The Late Cenozoic and Pennsylvanian are the two periods of highest Sr-87/Sr-86 ratio in sea water. These correspond to the times of most extensive glaciation during Phanerozoic. It is suggested that erosion of Precambrian shields by glaciers would be an effective means of adding radiogenic Sr-87 to the dissolved load input to the oceans. Lowering of sea level as a result of trapping of water in the ice sheets would act in concert with the glaciers in accelerating erosion of shield areas. Epeirogenic uplift would be a contributing cause of widespread glaciation, but is not necessary. If this hypothesis is correct, there should be another maximum in Sr-87/Sr-86 just prior to the beginning of the Cambrian. Volcanism and uplift may change the Sr-87/Sr-86 input of the oceans, but glacial activity perhaps is the dominant effect. — DBV

Arnold, Allan. *See* Walton, Brian J. 08353

00900 **Arrhenius, Gustaf; Alfvén, Hannes.** Fractionation and condensation in space: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 253-267, illus., 1971.

Observations in space suggest that the primordial condensations of solids in our solar system took place from a low density, partially excited gas, and that gas temperatures were much higher than temperatures of solid grains growing from this medium. Laboratory simulation of such condensation processes has provided information on characteristics of ensuing solids. Materials in meteorites have properties which in some cases permit, in others strongly suggest or require the assumption that they are primary and largely unaltered solids grown in extreme thermal disequilibrium with the surrounding gas phase. — *from* Authors' abstract

00797 **Ash, Robert G.** Boom describes Anadarko activity: Oil and Gas Jour., v. 69, no. 12, p. 166, 169, 170, 173-174, illus., 1971.

Petroleum exploration activity in the easern Anadarko basin has increased greatly due to the completion of three flowing wells in a previously untested area south of Northeast Verden field. The Marchand sand, evidently deposited as an offshore bar and associated channel sands, is the reservoir at Northeast Verden and the new producing area. Estimates of reserves range up to 1,000,000 bbl/well for some wells. — WBC

00802 **Atlantic Oceanographic Laboratory.** (Geophysics Section). Natural resource charts — Gravity, free air anomaly: Canadian Hydrog. Service, Marine Sci. Br. [Chart] 14928-B, 14938-B, and 15030-B, scale 1:250,000, explanatory notes, table, 1971.

Data were compiled from shipborne gravimeter measurements over the continental margin off Newfoundland. Depth contours are included. At the present time, accuracy of shipborne measurements is about two to three milligals under carefully controlled conditions. — ESL

00803 **Atlantic Oceanographic Laboratory.** (Geophysics Section). Natural resource charts — Magnetic, total field: Canadian hydrog. Service, Marine Sci. Br. [Chart] 14928-C, 14938-C, and 15030-C, scale 1:250,000, explanatory notes, table, 1971.

Data were compiled from proton precession magnetometer measurements along ship tracks over the continental margin off Newfoundland. Depth contours are included. — ESL

00948 **Atwell, B. Houston; MacDonald, R. B.; Bartolucci, Luis A.** Thermal mapping of streams from airborne radiometric scanning: Water Resources Bull., v. 7, no. 2, p. 228-243, illus., table, 1971.

A brief review is given of radiation theory as applied to water temperature determinations, including discussion of errors introduced in temperature measurements due to nonblackness of the water surface and the effects of the atmosphere. The airborne scanner system is described, and the analysis and display of scanner data using the Laboratory for Applications of Remote Sensing (LARS) display system are discussed. Thermal maps of four sections of the Wabash River are included, and points of interest are discussed. — *from* Authors' abstract

08384 **Ault, C. H.; Carr, D. D.** Locations of crushed stone operations in Indiana: Indiana Geol. Survey Misc. Map 11, scale 1:1,000,000, sections, revised 1970; originally published 1965.

Aumento, F. *See* Barrett, D. L. 08131

08291 **Austin, G. S.; Grant, J. A.; Ikola, R. J.; Sims, P. K.** Geologic map of Minnesota — New Ulm sheet, bedrock geology: Minneapolis, Minn., Minnesota Geol. Survey, scale 1:250,000, 1970.

00870 **Ayres, L. D.; Lumbers, S. B.; Milne, V. G.; Robeson, D. W.** (compilers). Ontario geological map, east central sheet: Ontario Dept. Mines and Northern Affairs Map 2198, scale 1:1,013,760, 1971.

00871 **Ayres, L. D.; Lumbers, S. B.; Milne, V. G.; Robeson, D. W.** (compilers). Ontario geological map, west central sheet: Ontario Dept. Mines and Northern Affairs Map 2199, scale 1:1,013,760, 1971.

00872 **Ayres, L. D.; Lumbers, S. B.; Milne, V. G.; Robeson, D. W.** (compilers). Ontario geological map, northeast sheet: Ontario Dept. Mines and Northern Affairs Map 2200, scale 1:1,013,760, 1971.

00873 **Ayres, L. D.; Lumbers, S. B.; Milne, V. G.; Robeson, D. W.** (compilers). Ontario geological map, northwest sheet: Ontario Dept. Mines and Northern Affairs Map 2201, scale 1:1,013,760, 1971.

Baadsgaard, H. *See* Green, D. C. 00735

00712 **Bada, Jeffrey L.; Luyendyk, Bruce P.** A route to Late Cenozoic temperature history, [Reply to discussion, 1971, by M. C. McKenna of "Marine sediments — Dating by the racemization of amino acids," 1970]: Science, v. 172, no. 3982, p. 503, 1971.

The paper under discussion was published in Science, v. 170, no. 3959, p. 730-732, 1970 (see Abs. North American Geology, April 1971; discussion, this issue).

00841 **Bailey, George D.** The fragipan menace and comprehensive planning in Megalopolis: Assoc. Am. Geographers Proc., v. 3, p. 25-28, 1971.

Fragipans, dense subsurface soil horizons of low permeability, are distributed through Megalopolis, with a heavy concentration in New York and New England. Seasonal perched water tables, caused by low permeability, high precipitation rates of the region, and low evapotranspiration rates of winter and spring affect the use of these soils. Urban development on fragipan soils results in numerous community problems, the most serious being health hazards from malfunctioning septic tank sewer systems. Comprehensive planning can provide solutions to soil-related problems of development but only when the tools are available for both inventory and interpretation of basic soil data. — *from* Author's abstract

08272 **Baker, I.; Ridley, W. I.** Field evidence and K, Rb, Sr data bearing on the origin of the Mt. Taylor volcanic field, New Mexico, U.S.A.: Earth and Planetary Sci. Letters, v. 10, no. 1, p. 106-114, illus., tables, 1970.

Major element and Rb, Sr, K_2O abundances allow the following rock types to be recognized in the Mt. Taylor volcanic field: early basanite flows and pipes; mildly undersaturated basalts; "big-feldspar" basalts; basaltic andesites; alkali andesites; dacites; and rhyolites. There is a marked composition gap between basalts and basaltic andesites. K/Rb, Rb/Sr, and Sr-87/Sr-86 data suggest that both alkali olivine basalt and the hypersthene normative "big-feldspar" basalts are mantle-derived, whereas andesites, dacites, and rhyolites, are not. It is suggested that the rhyolites have arisen by partial melting of the granite basement. — *from* Authors' abstract

08169 **Ball, N. L.** (compiler). Oil and gas pools of western Canada — Southern Alberta (information to March 31, 1970): Canada Geol. Survey Map 1316A, scale 1:760,320, 1970.

08170 **Ball, N. L.** (compiler). Oil and gas pools of western Canada — Northern Alberta and northeastern British Columbia (information to March 31, 1970): Canada Geol. Survey Map 1317A, scale 1:760,320, 1970.

08171 **Ball, N. L.** (compiler). Oil and gas pools of western Canada — Southern Saskatchewan and southwestern Manitoba with Yukon Territory and part of Northwest Territories (information to March 31, 1970): Canada Geol. Survey Map 1318A, scale 1:760,320, legend on 1316A, 1970.

00987 **Bambach, Richard K.** Adaptations in *Grammysia obliqua*: Lethaia, v. 4, no. 2, p. 169-183, illus., table, 1971.

The Graamysiidae are an important but little understood family of Paleozoic bivalves. Specimens of *Grammysia obliqua* (McCoy) from the uppermost Silurian Stonehouse Formation at Arisaig, Nova Scotia, permit interpretation of their functional morphology and autecology. *G. obliqua* was an immobile, semi-infaunal, filter-feeding bivalve. It lived fixed by a byssus, with the shell inclined about 40° to the sediment-water interface. Though incapable of opening the shell, the animal maintained contact with the environment through byssal and dorsal-posterior gapes. The dorsal-posterior gape was in a peculiar position for a bivalve and required some anatomical adaptation, but it was functionally efficient for the animal's life attitude, permitting vertically oriented inhalant and exhalant water currents. — *from* Author's abstract

Bancroft, G. M. *See* Williams, P. G. L. 00939

Banerjee, Subir K. *See* Liebermann, Robert C. 00661

Banner, J. A. *See* vanEverdingen, R. O. 00704

08251 **Barden, L.; Berry, P. L.** Model of the consolidation process in peat soils [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 119-127, illus., 1970.

A review is made of the various factors necessary to be taken into account in a complete theoretical treatment of one-dimensional consolidation of peat. Two different physical mechanisms involved in secondary consolidation of amorphous-granular and fibrous peat are discussed and are shown to be represented by similar non-linear rheological models. The non-linear viscosity law is described in terms of rate process theory, and gives a simple equation for basic effective stress-strain-time relationship of the soil skeleton. The pore pressure dissipation stage merely influences the time at which the compression joins the above basic creep line. A theoretical and experimental assessment is made of a number of factors likely to influence slope of the secondary tail C_a. The major factor likely to affect the field prediction of C_a is the departure from the K_o condition. — *from* Authors' abstract

08380 **Barnes, Lawrence G.** A re-evaluation of mandibles of *Allodesmus* (Otariidae, Carnivora) from the Round Mountain Silt, Kern County, California: PaleoBios, no. 10, 24 p., illus., tables, 1970.

A series of *Allodesmus* mandibles from the late middle Miocene Sharktooth Hill bonebed in the Round Mountain Silt of Kern County, Calif., forms the basis for a study of the variation in a sample including the holotype of *A. kelloggi* Mitchell (1966). The range of variation in the sample encompasses the features of the holotype of *A. kernensis* Kellogg (1922), and *A. kelloggi* is therefore considered a junior synonym of *A. kernensis*. The mandibles show variation in the position of teeth and the development of other structures. The magnitude of variation is comparable to that in a series of mandibles of the living species *Zalophus californianus* Lesson. — Author's abstract

08235 **Barnwell, W. W.** Hydrological applications of remote sensing in Alaska, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 103-104, illus., table [1970].

This paper discusses the problems of locating water supplies in Alaska where, in permafrost regions, free water is underlain by permafrost and overlain by ice in winter for at least 9 months of the year. Remote-sensing devices, such as thermal infrared imagery or microwave sensors, by measuring thermal parameters can locate unfrozen water of rivers or lakes under the ice or snow cover and can also detect unfrozen ground-water sources along rivers and streams. In designing remote-sensing programs and in selecting sensing devices to obtain necessary data on water sources, it is best to group the hydrologic problems in relation to available sensing techniques and to consider other factors as well as the limitations of the sensor, such as weather conditions, scale of imagery, and resolution. — EH

08131 **Barrett, D. L.; Aumento, F.** The Mid-Atlantic Ridge near 45° N. — [Pt.] 11, Seismic velocity, density, and layering of the crust: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1117-1124, illus., table, 1970.

Compressional wave velocities at pressures to 1000 kg/cm² and densities are given for rocks from 42 dredge hauls, which include vesicular and massive basalt, metabasalts, metagabbros, and serpentinites. Evidence is given for block faulting of original layered crust. A study of the velocities of layers at *in situ* pressures shows that they correlate well with the seismic layering of the oceanic crust. The velocity of the massive basalt layer is in agreement with that of layer 2. The underlying layer (metabasalts and metagabbros) exhibits higher velocity. None exceed 6 kmps, but at greater depths could exhibit the velocity of layer 3. Occurrence of serpentines at all elevations on seamounts implies they do *not* form a continuous layer, and because of lower velocities are probably not from layer 3; they are likely to be hydrated diapiric intrusives. — *from* Authors' abstract

08232 **Barringer, A. R.** Remote sensing techniques for mineral discovery, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 66-81, illus., tables [1970].

Present usage of remote-sensing techniques for detection and mapping of mineral deposits is confined to a combination of aerial photography, aeromagnetic mapping and electromagnetometer surveying, with the inclusion of gamma-ray detection methods in prospecting for radioactive ores. Applicability of various types of remote-sensing systems to mineral exploration is described. — EH

Barrows, A. G. *See* Kahle, J. E. 00744

Bartel, A. J. *See* Rosholt, J. N. 08423

Bartolucci, Luis A. *See* Atwell, B. Houston. 00948

00637 **Barton, Paul B., Jr.** The Fe-Sb-S system: Econ. Geology, v. 66, no. 1, Bateman issue, p. 121-132, illus., tables, 1971.

Phase relations from 300°-800°C have been determined using new experimental data (primarily measurement of activity of sulfur for various univariant assemblages) in conjunction with published information. Apparently contradictory mineral associations may well represent equilibration at different (but all low) temperatures with subsequent lack of reaction as temperature fell. Berthierite, gudmundite, and aurostibite are clearly stable only under conditions of relatively low sulfur activity. The tendency for the common ore mineral galena to react with berthierite to yield pyrrhotite plus a lead sulfantimonide operates to make berthierite a rather uncommon mineral. — WSW

00648 **Bateman, Paul C.; Lockwood, John P.; Lydon, Phillip A.** Geologic map of the Kaiser Peak quadrangle, central Sierra Nevada, California: U.S. Geol. Survey Geol. Quad. Map GQ-894, scale 1:62,500, separate text, 1971.

The quadrangle is on the gentle western slope of the central Sierra, where almost all streams are tributary to the San Joaquin. It is underlain by a variety of granitic rocks intruded at different times and with ages ranging from 210 to 80 m.y. Some remnants of the pregranitic sedimentary rocks outcrop on Kaiser Ridge. Following emplacement of the granitic rocks, the area was deeply eroded, and at about 10 to 15 m.y. ago the Sierra Nevada was tilted westward. About 3.5 m.y. ago volcanoes erupted, and the range was tilted again; during the Pleistocene the higher parts of the Sierra were mantled with glaciers, and huge valley glaciers flowed down the San Joaquin and its South Fork. Pumice fragments were blown over the area from an eruption in the Mammoth Lakes area to the north. — ESL

00854 **Bateson, J. H.; Hall, I. H. S.** Revised geologic nomenclature for pre-Cretaceous rocks of British Honduras: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 529-530, illus., 1971.

New field data suggest that the Maya and Macal Series are a single unit, and that the 'intrusive' Bladen Porphyry is a volcanic-pyroclastic unit within the Maya-Macal. Because of the similarity between the Maya-Macal of British Honduras and the Santa Rosa Group of the rest of Central America, we propose that the term, Maya-Macal, be replaced by Santa Rosa Group and the Bladen Porphyry be replaced by Bladen Volcanic Member. — Authors' abstract

Bath, G. D. *See* Carr, W. J. 00879

08261 **Bay, R. R.** The hydrology of several peat deposits in northern Minnesota, U.S.A. [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 212-218, illus., table, 1970.

A comprehensive peatland hydrology study has provided data on the climate, hydrogeology, water table levels, and run-off from forested peat deposits in northern Minnesota. Groundwater studies identified two types of hydrogeologic situations — perched bogs, independent of the underground flow system, and groundwater bogs, which were influenced by storage changes in the surrounding groundwater basin. Because the water tables are near the surface in undisturbed bogs, they are important in peatland hydrology. Bog water table levels indicated storage opportunity, and their reaction to precipitation was influenced in part by the type of peat material in the zone of active fluctuation. Run-off was not evenly distributed. Most of the annual water yield occurred in spring before June 1, while summer and fall water yields were generally low. Run-off was directly related to water level in the peat deposits. — Author's abstract

08413 **Bayliss, P.; Levinson, A. A.; Klovan, J. E.** Mineralogy of bottom sediments, Hudson Bay, Canada: Bull. Canadian Petroleum Geology, v. 18, no. 4, p. 469-473, illus., tables, 1970.

Bottom samples from 450 stations in Hudson Bay were studied by X-ray diffraction powder methods. The clay minerals are chiefly illite and kaolinite with smaller amounts of montmorillonite and chlorite. Quartz, feldspar, dolomite, calcite and amphibole are the main non-clay mineral components. No mineralogical zonation correlating with the known bedrock exposed on the bottom of Hudson Bay was found. Statistical analysis by factor analysis showed three natural groupings of the minerals as follows: feldspar, quartz and amphibole; calcite and dolomite; and clay minerals. These can be correlated with the mineralogy of the rocks surrounding the shoreline. A similar conclusion was reached earlier by Pelletier (1969), who observed that ice-rafted sediments are most common within the nearshore area and reflect the nature of the underlying and bordering bedrock. — Authors' abstract

Becher, Albert E. *See* Meisler, Harold. 08365

08142 **Beecham, A. W.** The ABC Fault, Beaverlodge, Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1264-1274, illus., 1970.

This fault, striking northwest and dipping southwest, runs between the Black Bay and St. Louis faults. A left-hand, normal oblique movement is evident, and this, combined with the displacement of the Martin Formation gives a net slip of 12×10^3 feet. The southwest side moved down and southeastward relative to the northeast side. Movements on faults in the area imply two main orientations of principal stresses. These orientations apparently occurred at different stages in the uplift of a northeast-southwest elongated dome. — HRC

00964 **Beer, R. M.; Gorsline, D. S.** Distribution, composition and transport of suspended sediment in Redondo Submarine Canyon and vicinity (California): Marine Geology, v. 10, no. 3, p. 153-175, illus., 1971.

Redondo Canyon in the southern half of Santa Monica Bay is an active submarine canyon. Streams, waves, rip currents and marine slumping are agents for the suspension of sediment, which is transported by density suspension at the thermocline, in-

ternal waves, and near-bottom currents. Subsurface distribution of suspended sediment is controlled by the canyon's topographic effects on current flow, but wind-driven currents control distribution of surface suspended sediment. Surface concentrations are highest on the sides of the canyon, and decrease with distance from shore. Suspended sediment concentrations are highest at the surface and down to the thermocline, then decrease rapidly, but are very high near the bottom due to suspension of material by bottom turbulence and to the presence of material suspended within the nearshore area and in the process of seaward transport. — *from* Authors' abstract

Belichenko, V. P. *See* Povarennykh, A. S. 08295

00930 **Belnap, Dennis W.** Petrology and geochemistry of shoal water carbonates of the Virgin Limestone Member, Triassic Moenkopi Formation, Clark County, Nevada: Brigham Young Univ. Geology Studies, v. 18, pt. 1, p. 147-184, illus., table, 1971.

Five study sections of the Virgin Limestone, measuring at least 20 feet, contain two carbonate cycles representative of numerous cycles found in the lower part of the Virgin Limestone in Clark County. Carbonate cycles were formed during marine transgression out of the miogeosyncline over the shelf. Eighty samples were collected from the five study sections; 70 thin sections were prepared, and samples were analyzed for Ca, Mg, Si, Al, K, Na, Fe, and Sr. Data obtained was used to divide the cycles into three parts as follows: a basal transgressive unit, a medial regressive unit containing phylloid algal bioherms, and an upper tidal flat unit composed of cross-bedded terrigenous calcisiltites. Lateral chemical variations in the basal transgressive unit are useful as indicators of shoreline direction, proximity, and possible means for location of carbonate banks. — *from* Author's abstract

08387 **Berg, Norman A.** Urban sediment can be controlled, *in* National Conference on Sediment Control, Washington, D.C., 1969, Proc: Washington, D.C., U.S. Dept. Housing and Urban Development Environmental Planning Division, p. 8-17, 1970.

The Soil Conservation Service began in 1935, to help fight loss of soil by wind and water, particularly in the Great Plains dust bowl and deep-gullied Southeast. District units were formed in every State, most of them now on county lines. Since no one conservation practice would work everywhere, soil surveys became essential to fit treatments to the land involving 70,000 kinds of soils in the United States. Each set of maps has a descriptive text telling how soil properties influence land use and what treatment it needs. As rural problems cannot be separated from urban ones, soil surveys were shared in planning urban conservation and land use patterns, and involvement in watershed projects was broadened. Sediment pollution in rapidly developing suburbia is an increasing challenge; paved shopping centers create real water problems. Protection pointers are outlined. — GDC

00980 **Bergantino, Robert N.** Submarine regional geomorphology of the Gulf of Mexico: Geol. Soc. America Bull., v. 82, no. 3, p. 741-752, illus., 1971.

Recent work in the Gulf of Mexico has provided sufficient new data to update regional geomorphic classification. The Gulf region is divided into three major geomorphic divisions and sixteen provinces. Some of the provinces are further subdivided into sections and subsections. Most sections of the continental shelf contain Pleistocene wave-cut terraces, the lowest generally near a depth of 65 fm. The continental slope is considered a major geomorphic division, rather than a province, because of its variety of landforms and areal differences in geomorphic history. The steepness of the continental slope ranges from 2° to greater than 45°. Diapirs underlie all non-carbonate slopes and have largely altered the pre-existing topography. Great thicknesses of evenly bedded sediments underlie the Gulf floor. The deeper sediments, derived from the northwest, pre-date the salt tectonism that produced Sigsbee Escarpment and the numerous diapirs. — *from* Author's abstract

00886 **Berger, A. R.** Dynamic analysis using dikes with oblique internal foliations: Geol. Soc. America Bull., v. 82, no. 3, p. 781-785, illus., 1971.

Oblique, sinusoidal, internal foliations in dikes appear to result in many cases from lateral slip of dike walls, prior to complete consolidation. A population of variably oriented synchronous dikes of this kind should permit the determination of the directions of the principal stresses. The dynamic analysis can be obtained from standard stereoplot methods. — AG

00645 **Berger, Jon.** Some observations of the San Fernando, California earthquake with a laser strain meter, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 150-152, illus., 1971.

The peak dynamic strain recorded on the digital interferometric laser strain meter at Cape Elliott Geophysical Observatory, University of California, San Diego, for the San Fernando earthquake was 6×10^{-7} at a period of 8.6 sec. Data recorded around earthquake time were low passed through a zero phase shift digital filter, and the offset at the time of the earthquake was found to have a magnitude of 1.6×10^{-9}. Data from an extended period show a change in secular strain rate from 4×10^{-9} per day to 8×10^{-9} per day at the time of the earthquake $\pm$ 8 hours. Changes of this magnitude, not coincident with earthquakes, have been observed before, but such a sudden change is not normal. — VSN

Bergstrom, S. M. *See* Sweet, W. C. 00981

00775 **Berkner, Lloyd V.; Marshall, Lauriston C.** Oxygen and evolution, Chap. 10 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 142-149, illus., 1971.

Publication in 1965 of the theory outlined in this chapter resulted in a re-appraisal of generally accepted ideas in other fields of knowledge. The authors consider the effects of ultraviolet radiation on the Earth's primitive atmosphere, and on organic compounds, including DNA, precursors to the development of life, and conclude that the oxygen content of the Earth's atmosphere both influenced, and was caused by, the progressive development of life. This theory accounts for periods of explosive evolution, and may explain subsequent catastrophes such as extinction of the dinosaurs. — ESL

08343 **Berry, Edward L.** Ground water quality in Stanly County, North Carolina: North Carolina Div. Ground Water Ground-Water Circ. 15, 24 p., illus., tables, 1970.

This investigation was a special study of ground-water to ascertain the existence, source, and extent of a bacteriologic pollution. Results indicate that ground water of suitable quantity and quality for domestic and other water needs is available throughout the county. The ground-water supply is not polluted, although individual wells do show pollution as a result of poor construction and improper finishing. There is no evidence that the Rocky and Yadkin Rivers are a source of ground-water pollution. Chemical and physical analyses of well water are tabulated and geophysical logs of selected wells are given. — VSN

Berry, P. L. *See* Barden, L. 08251

00823 **Best, Myron G.; Wilshire, H. G.** Ultramafic inclusions in basaltic and kimberlitic rocks: Geotimes, v. 16, no. 4, p. 20-21, 1971.

The authors summarize the views of various scientists on modal composition, textures, and chemical properties of ultramafic inclusions as expressed at the Penrose Conference held November 29 to December 4, 1970, near Phoenix, Ariz. Inclusions seen at the San Carlos "peridot" workings included those characterized by emerald-green chrome diopside or by black pyroxenes; the latter is possibly a deep-seated cognate precipitate. Green-pyroxene lherzolite inclusions have been interpreted as primitive upper mantle material, residues from partial fusion, or precipitates of basalt magma. Speakers discussed the origin and abundance of hydrous minerals in the mantle, and evidence for noncognate origin of amphibole and phlogopite was given. Results of investigations of water- and other volatile-bearing systems at high pres-

sures and temperatures were discussed, based on the fact that mantle-derived basaltic magmas are hydrous. Papers were given on South African kimberlite pipes and their inclusions. — EH

00788 **Bewers, J. M.** North Atlantic fluoride profiles: Deep-Sea Research, v. 18, no. 2, p. 237-241, illus., table, 1971.

Fluoride analyses have been carried out on 152 samples from nine stations: seven at 46° N. in the median valley of the Mid-Atlantic Ridge and two at 33° N. in the Cape Verde Basin. No increases in the fluoride concentration with depth, as reported for some locations by Greenhalgh and Riley (1963) and Riley (1965), were detected. The mean fluoride concentration found was 1.35 ± 0.03 mg/l (1.32 ± 0.03 μg/g). The mean fluoride/chlorinity ratio given by these stations is $(6.82 \pm 0.12) \times 10^{-5}$ which agrees well with Riley's (1965) value of $(6.7 \pm 0.1) \times 10^{-5}$ for surface and normal deep waters. — Author's abstract

08347 **Bideaux, Richard A.** Mineral rings and cylinders: Mineralog. Rec., v. 1, no. 3, p. 105-112, illus., 1970.

The tendencies of different microscopic mineral crystals to form rings and cylinders almost defy explanation. The crystal structure and crystal chemistry involved in cylindrical crystals of layer silicates have received most study. The tubular morphology of haloysite (Bates, et al., 1950) depends on a slight mismatch between two kinds of sheets, as does the wider spaced kaolin structure (Bragg, et al., 1965). Similar chrysotile has even larger mismatch, and some multiple tubes within tubes. Fine scanning electron micrographs show in rings jamesonite from Roumania, boulangerite from Madoc, Ontario, and pyrite from Hall's Gap, Kentucky; also open helical forms and twisted acicular fiber bundles that may be part of the puzzle of ring formation. Neither epitaxial overgrowth of one mineral species on another, nor a two-component nutrient solution in which one formed immiscible spherical droplets within the other, fully account for formation of cylinders; their nucleation and growth to larger size is problematical. — GDC

Bielenstein, H. U. *See* Eisbacher, G. H. 00639

Biesecker, J. E. *See* Cobb, Ernest D. 00689

Bjork, Philip R. *See* Hibbard, Claude W. 00976

Blacet, Philip M. *See* West, Walter S. 00720

00771 **Blackburn, W. H.; Griswold, T. B.; Dennen, W. H.** Spectrochemical determination of trace elements in the U.S.G.S. silicate rock standards: Chem. Geology, v. 7, no. 2, p. 143-147, tables, 1971.

Spectrographic determinations for twenty trace elements in the six new U.S.G.S. silicate rock standards along with the rock standards G-1, W-1, SR-1, Gr and Br are given. Most of the results represent the average of triplicate determinations on each of five splits of the portions of the standards available to the authors. Thus, the preferred values represent, in most cases, the average of fifteen replicate determinations. — Authors' abstract

Blackwell, A. T. *See* Halliday, Ian. 00921

08407 **Blake, Weston, Jr.** Studies in glacial history in Arctic Canada — [Pt.] 1, Pumice, radiocarbon dates, and differential postglacial uplift in the eastern Queen Elizabeth Islands, *in* Symposium on recent crustal movements, Ottawa, Canada, 1969, Papers: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 2, p. 634-664, illus., tables, 1970.

Brown pumice associated with radiocarbon-dated wood on raised beaches of Ellesmere and Devon Islands shows the pumice arrived at the beach about 5000 yr ago. The widespread pumice serves as a time line and can be used to correlate widely-spaced marine features which are now at different elevations. In Arctic Canada, the

"pumice level" rises westward along Jones Sound — from 16.5 m a.s.l. at the mouth of South Cape Fiord, Ellesmere Island, to 24.0 m at the eastern tip of Colin Archer Peninsula, Devon Island, ca. 130 km away. It also rises northwestward toward the head of South Cape Fiord. There is, therefore, a region in the eastern and central part of the archipelago where > 25 m of uplift has occurred during the last 5000 yr. This region, including considerable areas that are now sea, is believed to have been covered by a major ice sheet during the last glaciation. — *from* Author's abstract

00988 **Bless, Martin J. M.; Jordan, Hanspeter.** The new genus *Copelandella* from the Carboniferous — The youngest known beyrichiacean ostracodes: Lethaia, v. 4, no. 2, p. 185-190, illus., 1971.

A palaeocope ostracode with prominent cruminal dimorphism, originally described as *Beyrichia novascotica* Jones and Kirkby, 1884, from the Lower Mississippian Horton Bluff Formation of Nova Scotia, is reassigned from Hollinacea to Beyrichiidae Matthew, 1886; hitherto, beyrichiids have been known only from the Silurian and Devonian. Because of distinctive lobation and adventral structure, this ostracode is made type species of *Copelandella*, n.gen. *Beyrichia hibernica* Jones and Kirkby, 1896, from the Viséan of Ireland, is considered conspecific with *C. novascotica*; its occurrence in strata of comparable age on both sides of the Atlantic, and in assemblages indicating nearshore or even brackish or nonmarine environment, supports the hypothesis that North America and Europe formed one supercontinent in the Paleozoic. — VMJ

Blick, John C. *See* Galusha, Ted. 00945

00833 **Blodgett, Robert H.** Southeastern Michigan — The land the glaciers left behind: Explorer, v. 13, no. 1, p. 4-10, illus., 1971.

All surface features in southeastern Michigan were formed between the Wisconsinan glacial advance about 70,000-80,000 B.P., and recession, about 17,000 B.P. Glacial drift left by the ice retreat is seen as till moraines in the uplands northwest of a line from Rochester to Ypsilanti, glacial lake deposits southeast of the line, and outwash plains and valleys in various areas. The ice sheets left striations, polish, and grooves, some over one foot deep on Kelley's Island. Erratics are from bedrock of the Great Lakes region and northern Ontario. The Erie lobe of the ice sheet left glacial lakes which are easily traced from beaches raised above the surrounding plain. Eight major lake stages are recorded in the area. Pleistocene flora, fauna, and the arrival of early Indians about 8,000-9,000 B.P. are discussed. — EH

00909 **Blount, C. W.; Morgan, W. R.; Leyden, D. E.** Preparation of pellets from ion-exchange resins for direct analysis for metal ions by X-ray spectroscopy: Anal. Chim. Acta, v. 53, no. 2, p. 463-466, table, 1971.

Combined applications of ion-exchange material and X-ray spectroscopy for elemental analysis have been in use for some time. The application of a chelating ion-exchange resin to determination of barium ions in solutions containing 1 *M* sodium chloride, and a technique for improvement in handling the treated resin are reported. Lanthanum was used as an internal standard. Pellets prepared from the resins were an improvement over loose resin beads. — ESL

08255 **Boelter, D. H.** Important physical properties of peat materials [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 150-154, illus., tables, 1970.

Peat materials from 12 bogs in northern Minnesota show significant differences in physical properties. These properties can be related to the hydrology of organic soils only if the soils represent undisturbed field conditions, and volumetric expressions of water content are necessary to correctly evaluate the amount of water in a peat profile. Differences in physical properties were related to degree of decomposition as measured by bulk density and fibre content. Undecomposed peats with low bulk density and high fibre content contain many large pores which yield as much as 80 percent of their saturated water content to drainage and permit rapid water movement.

With increasing decomposition, fibre content decreases, resulting in increased bulk density and a greater proportion of small pores. The most decomposed peats yield less than 10 percent of their water to drainage and have very slow water movement rates. — *from* Author's abstract

Boerngen, Josephine G. *See* Shacklette, Hansford T. 00957

Bohnenberger, Otto H. *See* Bonis, Samuel. 08376

Bolton, T. E. *See* Liberty, B. A. 00769

Bolton, T. E. *See* Liberty, B. A. 00770

00748 **Bonham-Carter, Graeme; Harbaugh, John W.** Stratigraphic modeling by computer simulation *in* Data processing in biology and geology — A symposium, Cambridge, England, 1969, Proc.: London, Academic Press (Systematics Assoc. Spec. Vol., no. 3), p. 147-164, illus., tables, 1971.

A very simple computer-simulation model of a sedimentary basin is developed which incorporates factors such as depth of water, rate of supply and composition of sediment, the effect of base-level control, subsidence of the crust, and eustatic fluctuation. Output from the model comprises a sequence of vertical stratigraphic sections, representing the configuration of water, lithofacies and basement rocks through time. The sections are displayed graphically using the computer's line printer and depict time lines as well as lithofacies boundaries. The model is illustrated with results from six experiments. A FORTRAN-IV listing of the program is included. — Authors' abstract

00613 **Bonilla, M. G.; Buchanan, J. M.** (and others). Surface faulting, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 55-76, illus., tables, 1971.

The San Fernando earthquake produced a zone of surface breakage which partly follows the boundary between the San Gabriel Mts. and the San Fernando-Tujunga Valleys, and partly transects the northern salient of San Fernando Valley. The latter zone was associated with some of the most extreme damage anywhere in the epicentral region. The zone of surface breakage trends roughly E-W, is about 15 km long, and is slightly concave towards the south. Near the middle of the arc the western half is offset about 1 km north of the eastern half. Along the entire 15 km length, maximum vertical offset measured on a single scarp is about 1 m, maximum lateral offset about 1 m, and maximum shortening (thrust component) about 0.9 m. Characteristics of each segment of the rupture zone are described in detail, and resulting damage is discussed and illustrated. — VSN

08376 **Bonis, Samuel; Bohnenberger, Otto H.; Dengo, Gabriel.** Mapa geológico de la República de Guatemala: Guatemala City, Guatemala Inst. Geog. Nac., 4 sheets, scale 1:500,000, 1970.

00749 **Bonyun, David; Stevens, George.** A general purpose computer program to produce geological stereonet diagrams *in* Data processing in biology and geology — A symposium, Cambridge, England, 1969, Proc.: London, Academic Press (Systematics Assoc. Spec. Vol., no. 3), p. 165-188, illus., 1971.

This paper describes a program which produces on the line printer a circular stereonet density diagram as used by geologists. Several different cases are handled, depending on the type of data available (micro-planar, micro-linear, field planar or field linear), the type of diagram required (standard or beta), and the type of computation required (step function influence or normal decay). Included as appendices are the listing of the program, sample data, sample requests, and sample diagrams. One of the major features of the program is its ability to show that if poles are assumed to exert influence according to an exponential decay function, the resulting diagram is not significantly different from that produced according to standard technique (a step decay function). — Authors' abstract

00783 **Bott, Martin H. P.** The interior of the Earth: New York, St. Martin's Press (London, Edward Arnold Ltd.), 316 p., illus., tables, 1971.

This book presents the modern picture of the structure and processes in the Earth's interior. Surface features such as ocean ridges, young fold mountains, trench and rift valleys are described only as their origin relates to deep structures and the ocean-floor spreading hypothesis. The text has nine chapters as follows: broad structure and origin of the Earth, continental crust, oceanic crust, mantle, core, terrestrial heat flow, continental drift by ocean-floor spreading, fracture and flow in the crust and mantle, and origin of the Earth's surface features. — VSN

08184 **Boucot, Arthur J.; Gauri, K. Lal; Southard, John.** Silurian and Lower Devonian brachiopods, structure and stratigraphy of the Green Pond Outlier in southeastern New York [with German abs.]: Palaeontographica, ser. A, v. 135, nos. 1-2, p. 1-59, illus., table, 1970.

Brachiopods of Pridoli (Late Silurian) and Gedinnian age, from the Decker Formation and Helderberg Group (Coeymans, New Scotland, Kalkberg formations) of the southeasternmost Siluro-Devonian outlier in the central Appalachians, are described for the first time, with additions to later Early Devonian Esopus and Pine Hill faunas; the 66 forms are all assigned to known species or genera. Structure of the more complex areas is mapped and described. Late Silurian and Early Devonian stratigraphy of the outlier is revised. Stony Ridge Group (informal) is used for the sequence of mudstones and fine sandstones between Oriskany-age strata and Middle Devonian Cornwall Shale. The lower formation of the sequence, the Esopus, is subdivided into four members, Mountainville (new), Quarry Hill (informal), Highland Mills (redefined), Eddyville (informal); the upper formation, the Pine Hill (new), is subdivided into the Woodbury Creek and Kanouse members. — VMJ

Bown, M. G. *See* Williams, P. G. L. 00939

08281 **Boyer, Robert E.; Higgins, Jon L.** Activities and demonstrations for earth science: West Nyack, N. Y., Parker Publishing Co., 286 p., illus., tables, 1970.

This book of experiments in earth science is intended as a teaching aid for junior and senior high school earth science teachers. The text is divided into four sections — geology, oceanography, meteorology, and astronomy — and 12 experiments are described in each section. Experiments are easily adapted to any grade level with any textbook or subject matter approach. Each basic investigation includes motivating suggestions, background information, lists of materials, student experimental procedures, analysis of results, and ideas for follow-up investigations; pertinent source information is indicated. — VSN

00723 **Brady, B. T.** The effect of confining pressure on the elastic stress distribution in a radially end-constrained circular cylinder: Internat. Jour. Rock Mechanics and Mining Sci., v. 8, no. 2, p. 153-164, illus., 1971.

In development of a mechanical equation of state for rock, a major problem involves the testing procedure to obtain a response characteristic of the rock alone, not combined with that of the loading system. The finite element method has been applied here to triaxial loading of a circular cylinder between nonrigid end-plates of the same diameter. For the range of values reported for confining pressure/applied axial stress, the confining pressure reduces both magnitude and vertical extent of the end-effect, i.e., the state of stress becomes more uniform as confining pressure is increased. The effect of radial end-constraint on measurements of Young's modulus and Poisson's ratio is insignificant for specimen length/diameter values equal to 2.0, provided the measurements are taken in central portions of specimen. — GDC

00724 **Brady, B. T.** An exact solution to the radially end-constrained circular cylinder under triaxial loading: Internat. Jour. Rock Mechanics and Mining Sci., v. 8, no. 2, p. 165-178, illus., 1971.

An exact theoretical solution for stresses and displacements in a radially end-constrained elastic cylindrical specimen, deformed axially between end-plates of dif-

ferent elastic properties from those of specimen, is expressed by a Fourier series representation. It satisfies four boundary conditions: (1) radial and tangential stresses equal to zero and/or to value of radial pressure applied to specimen surface; (2) shear stress is zero at all points along cylindrical surface; (3) ends of specimen remain plane under resultant applied axial force; (4) radial displacement along ends is specified by functional relation g(r), where radial distance is always less than or equal to radius of specimen. The functional form of this relation is determined by elastic properties and geometry of specimen and end-plates. — *from* Author's abstract

00798 **Brand, John P.; Reeves, C. C., Jr.** Mesozoic and Cenozoic geology of the Lubbock, Texas, region — Geol. Soc. America, South-Central Sec., 5th Ann. Mtg., 1971, Guidebook: Lubbock, Texas Tech. Univ., 28 p., illus., table, 1971.

Generalized sections of the High Plains escarpment and a table showing the Cenozoic stratigraphy are included. Discussions at stops cover the Ogallala Group, with caliche beds, Old Spring basin with Pleistocene lacustrine fill, three formations of the Triassic Dockum Group, formations of the Cretaceous Trinity, Fredericksburg, and Washita Groups, and the playa of the Guthrie Lake basin. — ESL

00917 **Brannock, Kent C.** Minerals of the spinel group from Alleghany County, North Carolina: Mineralog. Record, v. 2, no. 1, p. 43-44, illus., 1971.

Galaxite, gahnite, and magnetite are described, and the current collecting status in North Carolina is reviewed. Galaxite from Bald Knob, N.C., has a large amount of Fe, and it is possible that a complete series may exist between it and hercynite. X-ray diffraction patterns of alleghanyite from Bald Knob are very similar to those for tephroite and should not be used to distinguish them. Magnetite occurs abundantly in a field southeast of Bald Knob. Gahnite from the Stratford area, is from a small locality which is depleted, and collecting is not allowed. — ESL

Bredeson, D. H. *See* Johnson, Howard A. 00869

Brenninkmeyer, B. M. *See* Gorsline, D. S. 00743

Brew, David A. *See* MacKevett, E. M., Jr. 00685

00658 **Briggs, Reginald P.** Geologic map of the Orocovis quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-615, scale 1:20,000, sections, engineering geology table, separate text, 1971.

The Cretaceous Robles-Rio Orocovis sequence is correlated with adjoining quadrangles and across the Damian Arriba fault. Almost all of the sequence was deposited in a marine environment. Most rocks stratigraphically below the Achiote and Pozas have been metamorphosed. The axis of the here-named Saltos anticline of the Puerto Rico anticlinorium plunges westward. Three sets of faults are recognized, and 25 km of left-lateral movement is estimated along the Damian Arriba fault. No mineral deposits of any significance were found. — ESL

Brockman, S. *See* Espinosa, A. F. 00627

08168 **Brooke, J.; Irving, E.; Park, J. K.** The Mid-Atlantic Ridge near 45°N — [Pt.] 13, Magnetic properties of basalt bore-core: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1515-1527, illus., tables, 1970.

Three bore-cores containing basalts have been obtained from the Mid-Atlantic Ridge at 45°N. The material is fresh and ideal for the study of physical properties. The drilling record and the nature of the core itself suggest that much of the basalt is from detached boulders, although one core may be *in situ*. In one core, variations in coercivity by a factor of 2 occur within a distance of 5 cm. The coercive force spectra of anhysteretic and natural remanent magnetization are similar, but there are small differences due to secondary components which are used to predict correctly the polarity of 11 out of 12 specimens studied. This result may be of technical interest only since there is no guarantee that the material is *in situ*. — Authors' abstract

08122 **Brookes, Ian A.** New evidence for an independent Wisconsin-age ice cap over Newfoundland: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1374-1382, illus., 1970.

A reinterpretation of the relative ages of glacial striae in southwestern Newfoundland, and new evidence from erratic till-boulder provenances there, support an early view, since abandoned, that at the last glacial maximum the island supported its own ice cap and was not affected by ice from Labrador. — Author's abstract

Brooks, C. *See* Hart, S. R. 08270

Broussard, W. L. *See* Calandro, A. J. 08185

00842 **Brown, Dwight A.** A Kentucky solution cuesta revisited — An alternative explanation: Assoc. Am. Geographers Proc., v. 3, p. 38-40, illus., 1971.

Solutional processes have been advanced as the mechanism responsible for the relief of the Dripping Springs escarpment and for the basin karst topography at its base. Field examination of soils, recent published soils analyses, and trend-surface analysis of the topography suggest normal fluvial erosion as an alternative explanation. — Author's abstract

08199 **Brown, Eugene; Skougstad, M. W.; Fishman, M. J.** Methods for collection and analysis of water samples for dissolved minerals and gases: U.S. Geol. Survey Water-Resources Inv. Techniques, Book 5, Chap. A1, 160 p., illus., tables, 1970.

This manual is the first chapter in a series on laboratory methods for water analysis, part of a series of manuals on techniques for planning and executing specialized work in water-resources investigation, needed by developers, water-quality managers, and pollution-control agencies. An updating and enlargement of Water-Supply Paper 1454 (Rainwater and Thatcher, 1960), it describes methods used by the U.S. Geological Survey to collect, preserve, and analyze water samples for their content of dissolved minerals and gases. Among the topics discussed are selection of sampling sites, frequency of sampling, sampling equipment, sample preservation, laboratory equipment and instrumental techniques, accuracy and precision of analysis, and reporting of results. Given are 76 analytical procedures for determining 55 water properties, as listed with the principal procedure for the determination of each. — GDC

08388 **Brown, F. Raymond.** A case history in Contra Costa County, California, *in* National Conference on Sediment Control, Washington, D.C., 1969, Proc: Washington, D.C., U.S. Dept. Housing and Urban Development Environmental Planning Division, p. 20-25, 1970.

This county ranges in elevation from sea-level to the 3849-ft Mt. Diablo, half in steep hills of the Coast Range. Sedimentary materials are easily erodible, badly faulted, and subject to mud slides and massive landslides. Population growth since 1945 has changed its western land use from agriculture to residential. Problems include: natural stream erosion; development practices; river sedimentation and diversion of flows; farmland gullying; drainage ditches; and peat-land dust storms. Government agencies to control erosion and sedimentation are limited by public and political acceptance in amount of regulation that can be imposed by law. Eleven practices are outlined in the policy of the county. With early recognition of problems, and engineering with an eye to prevention and control, cost of repairing damage of erosion and sedimentation can be minimized. — GDC

Brown, R. C. *See* Horton, J. W. 00736

08258 **Brown, R. J. E.** Occurrence of permafrost in Canadian peatlands [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 174-181, illus., table, 1970.

Permafrost underlies about one-half of the total land area of Canada and occurs extensively in peatlands. The discontinuous permafrost zone, which is located mostly in the subarctic, lies in the belt of greatest peatland concentration. The distribution of permafrost and its thermal regime in this zone, particularly in the southern fringe, are

governed to a considerable degree by the thermal properties of the peat. Mapping the distribution of permafrost in peatlands is facilitated to some extent by its occurrence in such distinctive micro-relief features as peat plateaux and palsas. The identification of permafrost on aerial photographs is possible by the recognition of these features. Some differences in the occurrence of permafrost in peatlands appear to exist among the various physiographic regions, but more observations are required before completely reliable correlations can be made. — Author's abstract

08172 **Brownell, G. M.** Justin Sarsfield DeLury, 1884-1968: Royal Soc. Canada Minutes Proc. 1970, ser. 4, v. 8, p. 61-63, portrait, 1970.

Brugger, W. A. *See* Moran, D. F. 00635

08116 **Bryan, Rorke B.** An improved rainfall simulator for use in erosion research: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1552-1561, illus., table, 1970.

Artificial simulation of rainfall to produce controlled conditions is increasing in importance both as a laboratory and field research tool in a variety of disciplines. The development of a compact laboratory rainfall simulator for use in erosion research is described. This unit is capable of producing rainfall intensities from 1.27 to 91 cm/h with raindrops ranging from 0.50 to 5.28 mm in diameter. In an available fall height of 2.59 m these drops achieve estimated velocities ranging from 100 to 69.3 percent of terminal velocity. Rainfall characteristics produced are critically reviewed and laboratory operating procedures are described. — Author's abstract

08176 **Bryant, Bruce; Reed, John C., Jr.** Geology of the Grandfather Mountain window and vicinity: U.S. Geol. Survey Prof. Paper 615, 188 p., illus., tables, geol. map, 1970.

Plutonic rocks 1,000 to 1,100 m.y. old, a thick sequence of younger Precambrian sedimentary and volcanic rocks, and a thrust sheet of Cambrian miogeosynclinal rocks are exposed in the Grandfather Mountain window in the Blue Ridge thrust sheet in northwestern North Carolina, demonstrating that the entire Blue Ridge belt is allochthonous in that region and that in Cambrian time deposition of quartzite-carbonate assemblage rocks occurred southeast of the present position of the Blue Ridge Belt. A different terrane of metamorphic and plutonic rocks in the Inner Piedmont is juxtaposed against the Blue Ridge along the Brevard fault zone. Patterns in the minor structure suggest that strike-slip movement along the Brevard fault was essentially contemporaneous with thrusting. The faulting occurred after Late Devonian metamorphism and before emplacement of Late Triassic (?) diabase dikes. — BB

Buchanan, J. M. *See* Bonilla, M. G. 00613

Buchanan, Richard S. *See* Lumsden, David N. 00864

00920 **Buchwald, V. F.** A new cutting technique for meteoritic irons: Meteoritics, v. 6, no. 1, p. 27-31, illus., 1971.

Small iron meteorites may be cut with high-speed plastic-bonded carborundum wheels, with hacksaws or automatic modifications of these, and with carbide-tipped wheels; to date, no simple method has been available for cutting large iron meteorites. The successful sectioning of a 20-ton meteorite involved the use of a mason's wire-saw, fed with a slurry of carborundum-grit. The slab produced measured 1.8 × 1.3 × 0.05 m and could be ground and polished for deep-etching, with a minimum of weight loss. — Author's abstract

08179 **Bulman, O. M. B.; Rickards, R. B.** Classification of the graptolite family Monograptidae Lapworth, 1873 [addendum], *in* Treatise on invertebrate paleontology — Pt. V, Graptolithina, . . . (2d edition): Boulder, Colo., Geol. Soc. America (and Univ. Kansas), p. V149-V157, illus., 1970.

Taxa assigned to Monograptidae (p. V132-V134) are placed in the adequately defined genera *Monoclimacis*, *Pristiograptus*, *Rastrites*, *Saetograptus*, *Cucullograptus*,

and in the broadly inclusive *Monograptus*, under which 12 generic or subgeneric names are treated as subjective synonyms. In this addendum, reasons for accepting or rejecting each genus are discussed. Eight of the rejected genera are based mainly on thecal form; the other four are based mainly on rhabdosome shape. *Demirastrites*, *Pernerograptus*, *Pribylograptus*, and *Streptograptus*, based on thecal form, may be justifiable, but further subdivision of monograptids seems premature until better preserved specimens are studied and problems of thecal variation and complex phylogeny of species groups are clarified. — VMJ

08197 **Bulman, O. M. B.** Treatise on invertebrate paleontology — Pt. V., Graptolithina, with sections on Enteropneusta and Pterobranchia (2d edition): Boulder, Colo., Geol. Soc. America (and Univ. Kansas), p. V1-V163, illus., revised and enlarged, 1970; originally published 1955.

The class Graptolithina (Cambrian-Carboniferous, 183 genera) is here placed in the phylum Hemichordata, which also includes the classes Pterobranchia (Ordovician-Holocene, 7 genera) and the extant Enteropneusta and Planctosphaeroidea. Graptolites are classified herein under the orders Dendroidea, Tuboidea, Camaroidea, Crustoidea (Wimanicrustidae and Hormograptidae, n.fams.), Stolonoidea, and Graptoloidea (with Dicaulograptidae, n.fam.), except for 24 genera of uncertain affinity (many formerly in Dendroidea) and three small groups of unknown affinity. Graptoloidea (Ordovician-Lower Devonian, 108 genera) have been extensively revised, and divided into 4 suborders for the 14 families, to reflect clarification in phylogeny and increase in number of valid taxa. Morphology, paleoecology, geographic and stratigraphic distribution, and phylogeny are discussed fully under the appropriate orders. — VMJ

00732 **Burch, Stephen H.** Complete Bouguer gravity and general geology of the Cape San Martin, Bryson, Piedras Blancas, and San Simeon quadrangles, California: U.S. Geol. Survey Prof. Paper 646-A, p. A1-A12, illus., tables, geol. map, 1971.

The granitic-metamorphic Salinian block constitutes the basement in the northeastern part of this area, while the Franciscan Formation underlies most of the map area and forms all but a small part of Santa Lucia Range; Nacimiento fault separates these major basement blocks. Cretaceous and Tertiary marine deposits and nonmarine Paso Robles Formation overlie both basement units. Gravity data indicate the unserpentinized core of Burro Mtn. ultramafic body has a subsurface volume not greater than 1 to 2 cu km and extends no deeper than 2000 to 3000 feet. Regional gravity data define a gradient of 3 mgal per mi in the southern half, a 10-mgal high over Santa Lucia Range suggesting a density of over 2.8 g per cu cm, a broad low over Lockwood Valley reflecting 7,000 feet of low density sediments, and a gradient up to 20 mgal per mi across Bryson quadrangle representing a fault displacing the basement 5000 to 10,000 feet vertically. — *from* Author's abstract

00793 **Burchett, Charles R.; Moore, Gerald K.** Water resources in the upper Stones River basin, central Tennessee: Tennessee Div. Water Resources Water Resources Ser. 8, 62 p., illus., tables, 1971.

This basin has a thin soil cover overlying limestone formations of generally poor water-storage capabilities, resulting in low to moderate ground-water yield and highly variable streamflow. Ground water is available in most of the basin, primarily from cracks and solution cavities, but also from thick soils in the eastern Highland Rim where the weathered soil zone is as much as 40 feet thick. Well yields, following no consistent pattern, range from less than 1 to more than 4000 gpm. Springs occur throughout the basin but are more numerous near base of steep ridges in the eastern Highland Rim; their minimum yield ranges from less than 1 gpm to more than 800. Chemical quality of ground water varies from pace to place, 80 percent of the wells yielding very hard water, some with undesirable amounts of iron or sulfur. Surface water quality is good, but hard. — *from* Authors' abstract

00615 **Burford, R. O.; Castle, R. O.; Church, J. P.; Kinoshita, W. T.; Kirby, S. H.; Ruthven, R. T.; Savage, J. C.** Preliminary measurements of tectonic movement, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 80-85, illus., tables, 1971.

Instrumental measurements (leveling, triangulation, trilateration, vertical angle readings, surface breaks) within an area surrounding the tectonic surface disturbance were begun immediately following the San Fernando earthquake to show elevation and length changes at or near the time of the main shock, and to provide information on rate and amount of continuing movements. Results of comparisons between pre-earthquake (very good coverage in this area) and postearthquake measurements are shown in a table. Measurements show that this moderate magnitude earthquake was associated with surprisingly large, areally restricted, permanent crustal movements. — VSN

08414 **Burgat, Virgil A.; Fowler, Lowell W.; Fredericksen, Walter F.; O'Connor, Howard G.; Stallard, Alvis H.** Geo-engineering in northeastern Kansas — Highway Geology Symposium, 21st Ann., 1970, Field Trip: Lawrence, Kans., State Geol. Survey Kansas, 57 p., illus., 1970.

This field-trip guidebook of the 21st Highway Geology Symposium, held at Lawrence, Kansas, April 23, 1970, contains observations on a variety of highway design and construction problems in the area between Lawrence and Kansas City. Pennsylvanian rocks cropping out in the area and Pleistocene deposits overlying them are described. Slope stability, classification of excavations, subgrade and embankment stabilization, bridge foundations and other highway problems are discussed in relation to the glacial outwash sediments and alternating beds of limestone, shale and sandstone. Economic aspects of the area include quarrying and processing of gravel and of limestone for cement and for building blocks. An underground industrial, office and storage facility is described. — EH

Burlingame, A. L. *See* Simoneit, B. R. 00905

Burnett, D. S. *See* Podosek, F. A. 00896

08143 **Burwash, R. A.; Krupička, J.** Cratonic reactivation in the Precambrian basement of western Canada — Pt. 2, Metasomatism and isostasy: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1275-1294, illus., tables, 1970.

Large-scale deformation of crystalline rocks, coupled with metasomatic recrystallization during the Hudsonian orogeny resulted in changes, the main ones being: a significant increase in K_2O and Rb, significant decrease in CaO, MgO, Na_2O, and Sr, and unchanged Al_2O_3 and SiO_2, reflecting relative mobility of major oxides; marked increase in K feldspar combined with very marked increase in secondary minerals, clear-cut decrease in plagioclase and primary dark minerals, and a slight increase in quartz (disequilibrium cannot explain the coexistence of newly-formed microcline and low-grade minerals); and decrease in average density of deformed and K-metasomatized complexes, and the probable subsequent long-term isostatic adjustments in the western Canada sedimentary basin. — *from* Authors' abstract

08185 **Calandro, A. J.; Broussard, W. L.; Hosman, R. L.** Water resources of the Belmont-Marthaville-Robeline area, Louisiana: Louisiana Geol. Survey and Dept. Public Works Water Resources Pamph., no. 25, 21 p., illus., tables, 1970.

An evaluation is presented of available ground- and surface-water resources in the villages of Belmont and Marthaville and the town of Robeline, in west-central Louisiana. Present and prospective needs are relatively small because of sparse population in the area. A reservoir on Bayou Dupont at Robeline could sustain a draft rate of one million gpd, but existing floodwater-retarding reservoirs on Bayou Dupont subwatersheds Nos. 2 and 8 are not dependable sources because of low storage capacity. Fresh ground water is available from sands of the Wilcox Group at Belmont, Marthaville, and Robeline; estimated yields on the basis of drilling, range from 40 to 250 gpm. Test drilling is necessary at prospective well sites because of the variability in thickness of sands and in quality of water. — VSN

00640 **California Div. Mines and Geology.** The California Division of Mines and Geology today: California Geology, v. 24, no. 2, p. 26-39, illus., 1971.

The present organization and mission of the California Division of Mines and Geology are described as well as its various sections and districts, their programs, and personnel. — EH

00623 **California Division of Oil and Gas.** Oil and gas seepages and damage to oil field facilities related to the earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 117-118, illus., 1971.

Following the earthquake of February 9, a line of gas seepage was observed off Malibu Pier, but activity had declined 75 percent by February 10. Relatively little damage was sustained by facilities in nearby oil and gas fields as a result of the earthquake. Minor damage was reported to tanks, roads, and a few wells; line breakage occurred in several fields but caused only minor spillage. The Cascade field reported an increase in gas production. — VSN

Calk, L. C. *See* Wilshire, H. G. 00903

08249 **Cameron, C. C.** Relation of commercial quality of peat to bedrock and geologic structure [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 98-101, illus., 1970.

Ninety-five deposits in the northern Appalachian Mountains represent various geologic settings related to structural control of bedrock and to differential erosion. Analyses of these peats show that their characteristics are related to distribution of bedrock and unconsolidated material surrounding each deposit, and to the size and position of the drainage basin. Ash content, water-holding capacity, and fibre size reflect the form and the kinds of material of the depression walls and of the surrounding drainage basin. A nongenetic classification based on terrane factors forms the basis for estimates of peat resources in many kinds of environments. The peats of northeastern Pennsylvania illustrate how such a classification may aid in peat exploration. — Author's abstract

08213 **Campbell, William J.; Rasmussen, Lowell A.** A heuristic numerical model for three-dimensional time-dependent glacier flow, *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 177-190, illus., 1970.

The one- or two-dimensional models used for detailed analytical descriptions of glacier flow could not be used to study complex glacier features. In the new model described here, a Newtonian flow law is assumed, with a vertically integrated three-dimensional velocity vector, and assumed linear relation between volume transport and bottom shear stress. A few applications, in valley and cirque bed configurations with the same transverse profile, indicate its use in study of the complex interplay between glaciers and climate, and show how complex dynamic waves can be generated on glacier surfaces by simple causative mechanisms. Advantages in this kind of model appear to be that ice-to-ice and ice-to-rock friction are treated separately and stated explicitly, and that solutions are generated for an arbitrary bed and climate without empirical measurements. A power flow law rather than the linear Newtonian one may improve this model. — GDC

08086 **Canada Geological Survey.** Aeromagnetic series, Gogama, Nipissing, Timiskaming and Sudbury Districts, Ontario: Canada Geol. Survey Geophysics Paper 7076, scale 1:253,440, 1970.

08087 **Canada Geological Survey.** Aeromagnetic series, Timmins, Cochrane, Timiskaming and Sudbury Districts, Ontario: Canada Geol. Survey Geophysics Paper 7085, scale 1:253,440, 1970.

08088 **Canada Geological Survey.** Aeromagnetic series, Kirkland Lake, east half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8429, scale 1:31,680, 1970.

08089 **Canada Geological Survey.** Aeromagnetic series, Ramore, east half, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8430, scale 1:31,680, 1970.

08090 **Canada Geological Survey.** Aeromagnetic series, Matheson, east half, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 8431, scale 1:31,680, 1970.

08091 **Canada Geological Survey.** Aeromagnetic series, Kirkland Lake, west half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8432, scale 1:31,680, 1970.

08092 **Canada Geological Survey.** Aeromagnetic series, Ramore, west half, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8433, scale 1:31,680, 1970.

08093 **Canada Geological Survey.** Aeromagnetic series, Matheson, west half, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 8434, scale 1:31,680, 1970.

08094 **Canada Geological Survey.** Aeromagnetic series, Gowganda, east half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8435, scale 1:31,680, 1970.

08095 **Canada Geological Survey.** Aeromagnetic series, Matachewan, east half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8436, scale 1:31,680, 1970.

08096 **Canada Geological Survey.** Aeromagnetic series, Radisson Lake, east half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8437, scale 1:31,680, 1970.

08097 **Canada Geological Survey.** Aeromagnetic series, Watabeag River, east half, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8438, scale 1:31,680, 1970.

08098 **Canada Geological Survey.** Aeromagnetic series, Porquis Junction, east half, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 8439, scale 1:31,680, 1970.

08099 **Canada Geological Survey.** Aeromagnetic series, Gowganda, west half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8440, scale 1:31,680, 1970.

08100 **Canada Geological Survey.** Aeromagnetic series, Matachewan, west half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8441, scale 1:31,680, 1970.

08101 **Canada Geological Survey.** Aeromagnetic series, Radisson Lake, west half, Timiskaming District, Ontario: Canada Geol. Survey Geophysics Paper 8442, scale 1:31,680, 1970.

08102 **Canada Geological Survey.** Aeromagnetic series, Watabeag River, west half, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8443, scale 1:31,680, 1970.

08103 **Canada Geological Survey.** Aeromagnetic series, Porquis Junction, west half, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 8444, scale 1:31,680, 1970.

08104 **Canada Geological Survey.** Aeromagnetic series, Shinning Tree, east half, Sudbury and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8445, scale 1:31,680, 1970.

08105 **Canada Geological Survey.** Aeromagnetic series, Sinclair Lake, east half, Timiskaming and Sudbury Districts, Ontario: Canada Geol. Survey Geophysics Paper 8446, scale 1:31,680, 1970.

08106 **Canada Geological Survey.** Aeromagnetic series, Peterlong Lake, east half, Sudbury and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8447, scale 1:31,680, 1970.

08107 **Canada Geological Survey.** Aeromagnetic series, Timmins, east half, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8448, scale 1:31,680, 1970.

08108 **Canada Geological Survey.** Aeromagnetic series, Pamour, east half, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 8449, scale 1:31,680, 1970.

08109 **Canada Geological Survey.** Aeromagnetic series, Shinning Lake, west half, Sudbury District, Ontario: Canada Geol. Survey Geophysics Paper 8450, scale 1:31,680, 1970.

08110 **Canada Geological Survey.** Aeromagnetic series, Sinclair Lake, west half, Sudbury District, Ontario: Canada Geol. Survey Geophysics Paper 8451, scale 1:31,680, 1970.

08111 **Canada Geological Survey.** Aeromagnetic series, Peterlong Lake, west half, Sudbury and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8452, scale 1:31,680, 1970.

08112 **Canada Geological Survey.** Aeromagnetic series, Timmins, west half, Cochrane and Timiskaming Districts, Ontario: Canada Geol. Survey Geophysics Paper 8453, scale 1:31,680, 1970.

08113 **Canada Geological Survey.** Aeromagnetic series, Pamour, west half, Cochrane District, Ontario: Canada Geol. Survey Geophysics Paper 8454, scale 1:31,680, 1970.

Cande, Steven. *See* Rhoads, Donald C. 00792

08311 **Canright, James E.** Spores and associated macrofossils from the Devonian of Arizona, *in* Perkins, B. F., editor, Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, p. 83-88, illus., 1970.

Abundant naked, dichotomously branched stems of the *Hostimella* and *Taeniocrada* types, fibellite leaves of *Ginkgophytopsis*, reproductive structures identified as *Cooksonia* and *Yarravia*, and both micro- and megaspores are described from a gray shale

in the Martin Formation of the Salt River Canyon in central Arizona. Based on the nature of this unique fossil flora, the plant-bearing horizon (in the Beckers Butte Member) [makes it probable that the Arizona psilophyte flora is younger than] Emsian and not younger than early Frasnian age. — Author's abstract

Carmichael, C. M. *See* Killeen, P. G. 08129

Carmichael, C. M. *See* Lilley, F. E. M. 08144

00683 **Carpenter, Gordon L., Jr.** Map showing bedrock topography and subcrop of selected beds beneath alluvial deposits of part of the Owensboro West quadrangle, in Daviess County, Kentucky: U.S. Geol. Survey Misc. Geol. Inv. Map I-633, scale 1:24,000, 1971.

Carr, D. D. *See* Ault, C. H. 08384

00879 **Carr, W. J.; Gard, L. M.; Bath, G. D.; Healey, D. L.** Earth-science studies of a nuclear test area in the western Aleutian Islands, Alaska — An interim summary of results: Geol. Soc. America Bull., v. 82, no. 3, p. 699-705, illus., 1971.

Recent multi-disciplinary studies by the U.S. Geological Survey conducted on and near Amchitka Island have contributed to a better understanding of the geologic, hydrologic, and tectonic environment of the island as an underground nuclear test site. Three distinct volcanic episodes have been distinguished and dated. A general volcano-tectonic history of the arc is proposed. The islands in the vicinity of Amchitka have apparently been stable tectonically in the late Pleistocene and Holocene. Most of the gravity and magnetic data can be interpreted in terms of known structure and rock distribution. Marine geophysical data tend to confirm structural stability of the insular area and indicate a scarcity of sedimentary material on the insular slopes and shelf. Geologic effects of underground tests have been minor. — *from* Authors' abstract

Carter, B. A. *See* Kamb, Barclay. 00612

Carter, Claire, Eberlein, George Donald. *See* Churkin, Michael, Jr. 00698

00692 **Cartwright, Keros; Sherman, F. B.** Ground-water and engineering geology in siting of sanitary landfills: Soc. Mining Engineers AIME Trans., v. 250, no. 1, p. 1-6, illus., 1971.

Experience and research in Illinois suggest four activities relating to landfill disposal that warrant attention by geologists and engineers: (1) regional delineation of favorable and unfavorable hydrogeologic conditions to facilitate planning and preliminary screening of potential landfill sites; (2) site evaluations, with considerations of geologic materials, topography, water levels, flow systems, and local occurrence and use of water resources; (3) research on aspects of the hydrogeologic environment that control effects of, or are modified by, landfills; and (4) formulation of practices in siting, construction, and operation of landfills that prevent, mitigate, or isolate deleterious effects. — *from* Authors' abstract

00816 **Carver, Robert E.** Model studies of differential compaction [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology b. 89(ISH-UNESCO), p. 450-458, illus. [1971].

Phenomena of differential compaction of sediments can be reproduced in models employing liquid-solid suspensions subjected to differential vacuum. Suspensions of clay-sized particles which approximate porosity of young sediments are easily prepared and have viscosities and shear strengths much lower than other fracturable materials. Field observation and experiment indicate that response to differential compaction is differential subsidence coupled with fracture. Fracture effects vary in scale of displacement from thousands of meters, in regional contemporaneous faults that parallel the coast of Texas, to decimeters in fractures caused by recent withdrawal of ground-water and petroleum in Texas and Arizona. Model studies in-

dicate that a differentially compacting sediment mass fails in shear in a manner analogous to the failure of a simply supported beam. Therefore, fracture of the sediment mass should be predictable if sufficient information about physical properties is available. — *from* Author's abstract

Castle, R. O. *See* Burford, R. O. 00615

Castle, R. O. *See* Yerkes, R. F. 00805

08288 **Chagnon, J. Y.** Quinze Lake — Barriere Lake area, Rouyn-Noranda and Temiscamingue Counties: Quebec Dept. Nat. Resources Map 1643 (map of Geol. Rept. 134), scale 1:63,360, 1970.

08310 **Chaloner, William G.** The evolution of miospore polarity, *in* Perkins, B. F., editor, Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, p. 47-56, illus., 1970.

The evolutionary sequence from homospory through heterospory to seed habit is reviewed in terms of the "small spore" part of the life cycle. In early stages, Devonian-Carboniferous, the miospore shows little modification. The earliest to function as pollen grains still retained proximal germination via a triradiate suture; the term "-prepollen" is redefined to cover such cases. Change from proximal to distal germination occurred independently in cordaites and pteridosperms. Behavior of pollen in living cycads shows an intermediate state between prepollen and true pollen of conifers; although germination of cycad pollen is distal, release of sperm is proximal. Change from the (distally) monocolpate to ubiquitous triaperturate pollen in angiosperms took place during Cretaceous. One possible route of derivation is represented by the trichotomocolpate aperture in pollen of a few living angiosperms. — *from* Author's abstract

Chan, K. M. *See* Grasshoff, K. M. 00847

Chang, Y. Y. *See* Ackermann, Norbert L. 00838

08323 **Chase, T. E.; Menard, H. W.; Mammerickx, J.** Bathymetry of the North Pacific (with diagrammatic abyssal topography): San Diego, Calif., California Univ. Inst. Marine Resources, 10 sheets, scale about 1:6,000,000, with text, 1970.

The charts are an interpretation of sea-floor relief using contours and diagrammatic symbols. The base contour interval of 200 fathoms was selected to show the greatest detail consistent with the quality of the data. The 100 fathom contour is a dashed line, and 20 fathom lines are included on wide continental shelves and deep-sea fans. Two sheets are devoted to profiles. The area covered extends as far south as the equator. — ESL

Cheney, Eric S. *See* Patton, Thomas C. 00693

08269 **Chesworth, Ward.** A chemical study of sodium-rich gneisses from Glamorgan Township, Ontario (Canada): Chem. Geology, v. 6, no. 4, p. 297-303, illus., tables, 1970.

The origin of certain Grenville gneisses with Na_2O/K_2O ratios greater than 1 is discussed with the aid of chemical analyses. An origin from dacitic volcanics or possibly from dacite-derived greywackes is indicated. — Author's summary

00726 **Chinnery, Michael.** The Chandler wobble, Chap. 6 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 88-95, illus., 1971.

The Earth has a measurable 14-month wobble with respect to its axis of rotation. The author shows just what the Chandler wobble is, describes how it was discovered, and discusses its possible causes, with special reference to earthquakes. If it can be

demonstrated that the Chandler wobble is excited by earthquakes, one problem may be solved, but many new questions shall have been introduced about misunderstandings of earthquakes. The damping of the wobble remains a mystery; the Earth somehow acts as though it were much more fluid than expected. — ESL

Christian, R. P. *See* Keidel, F. A. 00911

Church, J. P. *See* Burford, R. O. 00615

00698 **Churkin, Michael, Jr.; Carter, Claire, Eberlein, George Donald.** Graptolite succession across the Ordovician-Silurian boundary in south-eastern Alaska: Geol. Soc. London Quart. Jour., no. 503, v. 126, pt. 3, p. 319-330, illus., table, 1971.

The first discovery in North America of a succession of graptolite faunas across the Ordovician-Silurian boundary has been made on Esquibel Island in southeastern Alaska, where 5 graptolite zones are represented in an 18-m interval of shale in the Descon Formation. Despite the thinness of the zones, no stratigraphic breaks can be inferred from more complete graptolite successions known elsewhere. The Alaskan faunas can be closely correlated with those of standard British zones — the *Dicellograptus anceps* Zone (uppermost Ordovician), the *Glyptograptus persculptus* Zone (lowermost Silurian) and the overlying *Akidograptus acuminatus*, *Orthograptus vesiculosus* and *Monograptus cyphus* Zones of the Lower Silurian. They give evidence of cosmopolitan distribution of graptolite faunas during latest Ordovician and Earliest Silurian time. — *from* Authors' abstract

08283 **Claiborne, Robert.** Climate, man, and history: New York, W. W. Norton and Company, 444 p., illus., 1970.

The theme of this book is man's social interaction with his climatic environment. A second and more important theme is to demonstrate that science, despite its limitations and the limited capacities of its practitioners, is our most useful tool for understanding both environment and society. The text is in four parts: climate past and present (seven chapters); climate and emerging man (15 chapters); climate and civilization (10 chapters); and climate and history (eight chapters). — VSN

08182 **Clark, Lorin D.** Geology of the San Andreas 15-minute quadrangle, Calaveras County, California: California Div. Mines and Geology Bull. 195, 23 p., illus., tables, geol. map, 1970.

The quadrangle is underlain chiefly by folded and metamorphosed rocks of late Paleozoic and Mesozoic age, intruded by ultramafic and felsic plutonic rocks. Paleozoic rocks are mostly altered chert and carbonaceous shale with some carbonate and volcanic rocks. Upper Jurassic beds consist of pyroclastics, silty slate, graywacke, and conglomerates. Chemical analyses of 11 volcanic rocks suggest that the original composition was altered by post-eruptive processes. The metamorphic rocks are cut by two steeply dipping major fault zones, along one of which Paleozoic strata are juxtaposed against Upper Jurassic. Very incomplete production records show that more than 54 million dollars in gold was recovered from lode and placer deposits. The chief mineral industry in more recent years has been limestone for cement. — *from* Author's abstract

Clarke, D. B. *See* Park, I. 00898

00622 **Clifton, H. Edward; Greene, H. Gary; Moore, George W.; Phillips, R. Lawrence.** Methane seep off Malibu Point following the San Fernando earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 112-116, illus., 1971.

Methane gas that seeped from the sea floor off Malibu Point following the San Fernando earthquake may have originated from decay of organic material in Holocene or Pleistocene sediments or may have formed in underlying Miocene bedrock. Radioisotope analysis of the gas, now in progress, may establish its age and origin. Trend and location of the seep may be controlled by ancient channels incised in

bedrock, structural attitude of underlying strata, or fractures through these strata. The seep was not accompanied by active faulting; no detectable rupture or dislocation of sediment surface occurred along the seep as a result of the San Fernando earthquake. — *from* Authors' conclusions

00728 **Cloud, Preston, Jr.** The primitive Earth, Chap. 11 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 150-155, illus., 1971.

An internal source was proposed for the terrestrial atmosphere even before its depletion in noble gases was recognized. Discussion now focuses on composition and time of origin. Easily oxidized minerals in sedimentary rocks indicate that the atmosphere between 3.2 and 1.8 eons ago did not contain free oxygen. Geologic evidence for tides does not exist in rocks older than 3.2 eons, but tidal amplitude too great for the solar component alone existed at least two eons ago. Tidal friction due to Moon capture would have induced subcrustal melting and promoted out-gassing and accretion of atmosphere and hydrosphere. Hematitic iron ores and red beds disposed of free oxygen before the oxygen-releasing photosynthesizers burned themselves up. Red beds appeared in abundance at about the time that free oxygen began to accumulate in the atmosphere. The eucaryotic cell also evolved at this time. The oldest rocks in which these fossils are found are about 1.2 to 1.4 eons old. — ESL

Cloud, W. K. *See* Maley, R. P. 00633

00689 **Cobb, Ernest D.; Biesecker, J. E.** The national hydrologic bench-mark network: U.S. Geol. Survey Circ. 460-D, 38 p., illus., 1971.

The bench-mark basins and types of data collected are described for 57 basins in 37 states comprising a national network. The network was established in areas relatively unaffected by the increasing population to document natural changes in hydrologic characteristics with time, to understand the hydrologic structure of natural basins, and to provide a comparative basis for determining the effects of man on the hydrologic environment. — VSN

08139 **Cochrane, N. A.; Hyndman, R. D.** A new analysis of geomagnetic depth-sounding data from western Canada: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1208-1218, illus., 1970.

Time varying geomagnetic fields observed in southern British Columbia and Alberta are analyzed using optimum "transfer function" techniques for periods from 4 to 240 min. Estimates of the frequency and spatial dependence of the "coast effect" are obtained. Inland anomalies are delineated and attributed to variations in conductivity in the upper-to-middle crust coupled with an abrupt east-west transition in deeper conductivity. Regional attenuation of the uncorrelated portion of the vertical magnetic component is indicative of high conductivity near the crust mantle transition zone under the western part of the Cordillera. The conclusion is in agreement with magnetotelluric observations and other geophysical data. — Authors' abstract

00655 **Coffman, D. M.; Turner, A. K.** Computer determination of the geometry and topology of stream networks: Water Resources Research, v. 7, no. 2, p. 419-423, illus., tables, 1971.

Previously proposed binary string procedures for describing stream network topology do not assist studies that require network geometry information. A procedure is described here that studies stream networks by using both coordinate data describing point geometry and topologic data describing network links. Two years of experience with this extension of the binary string procedure has demonstrated its effectiveness in complete analysis of real stream networks. — VSN

08410 **Coker, A. E.; Marshall, R.; Thomson, N. S.** Application of computer processed multispectral data to the discrimination of land collapse (sinkhole) prone areas in Florida, *in* Earth Resources Aircraft Program, status review, V. 1: Houston, Tex., U.S. Natl. Aeronautics and Space Admin., Manned Spacecraft Center, p. 2-1—2-17, illus., tables, [1970?].

Data were collected near Bartow, Florida to study land collapse phenomena using a multispectral scanner system which consisted of combinations of 18 spectral bands ranging from 0.4 to 14.0 micron and several types of photography. Data in these spectra contain information about vegetation physiology and soil conditions and after special processing can be used as indicators of hydrogeologic conditions related to sinkhole occurrence. The data processor computes as much as eight Gaussian density functions with as many as 12 spectral bands. A likelihood function is then computed and tested, and results given are in the form of video signals printed on film to show pattern of distribution of proposed hydrogeologic indicators. Terrain temperature patterns compared with moisture stressed vegetation patterns show distinctive patterns that correlate with known sinkholes in the area. — VSN

Cole, E. R. *See* Shuey, R. T. 08206

Coleman, J. M. *See* Wright, L. D. 00845

08225 **Colwell, Robert N.** Gains to be made in natural resource management through the use of remote sensing systems, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 5-26, illus., tables [1970].

This paper describes the gains made in natural resources management through the use of remote-sensing systems, outlines basic principles involved in remote sensing, and describes sensing devices and platforms currently being used in procuring data as well as equipment used in analyzing the data. Examples of application of these systems to natural resources management are given and major advantages and limitations associated with their use described. — EH

08183 **Conklin, Kathleen.** Post-Columbian birds from Abaco Island, Bahamas: Florida Acad. Sci. Quart. Jour., v. 33, no. 3, p. 237-240, 1970.

A partially excavated cave deposit on Abaco Island has yielded, from a small amount of matrix, many fossilized mammal bones, and bird bones representing 12 genera and 19 species in the Columbidae, Cuculidae, Picidae, Tyrannidae, Mimidae, Turdidae, Vireonidae, Parulidae, Thraupidae, Icteridae, and Fringillidae. Abaco has had no previous record of fossil bird remains; there have been three previous reports elsewhere in the Bahamas (Wetmore, 1937, 1939; Brodkorb, 1959). Two of the species have been reported as fossils from the Bahamas, two from Florida only, one from California only, and at least five have no previous fossil record. Associated rodent bones of *Rattus* sp. indicate a post-Columbian age for the bird bones; for the most part, they correspond to species currently inhabiting the Bahamas. — VMJ

00677 **Connally, G. Gordon.** An Appalachian project for beginning geology: Jour. Geol. Education, v. 19, no. 2, p. 73-75, illus., 1971.

The Appalachian Project is an integrated five-week project for teaching about geologic maps. The project frees the student to work at his own pace either within or outside the laboratory. Each student receives a 15′ topographic quadrangle from the Valley and Ridge Province of Pennsylvania and a generalized geologic map of the area. The student identifies rocks and fossils encountered in the area and completes a stratigraphic column. He also completes a cross profile as the basis for a structure section that uses the generalized geologic map and topographic expression as guides. The student then constructs a more detailed geologic map of the quadrangle from the topographic expression of the rock units, and completes a report on the geologic history and economic prospects of the map area. — *from* Author's abstract

00943 **Cook, D. G.; Aitken, J. D.** Geology, Colville Lake map-area and part of Coppermine map-area, Northwest Territories: Canada Geol. Survey Paper 70-12, 42 p., illus., table, geol. map, 1971.

This report summarizes briefly the stratigraphy and regional geology of this area to accompany the geologic map (12-1970). Proterozoic to Upper Cretaceous rocks are present, interrupted by pronounced sub-Cambrian and sub-Cretaceous unconformities, and less obvious sub-Upper Ordovician and sub-Devonian unconformities. Colville Hills and northern Franklin Mountains reflect compressional structures, an-

ticlines, and thrust blocks developed above a décollement in shale and evaporites of the Cambrian Saline River Formation. Greatest economic potential is for oil and gas. Appendixes list fossil collections identified by B. S. Norford, A. E. H. Pedder, J. A. Jeletsky, and T. P. Channey. — VSN

00932 **Cooper, Margaret.** Selected annotated bibliography on the geochemistry of gold: U.S. Geol. Survey Bull. 1337, 63 p., 1971.

This bibliography of approximately 200 references is complete through 1969 and very early 1970 and covers both the foreign and domestic literature on geochemistry and genesis of gold deposits and geochemical prospecting techniques for use in gold exploration. Among the specific phases of these subjects included in the bibliography are: abundance of gold in nature; chemical forms of gold occurrence; indicator elements; mineral associations; ore guides; and types of gold ore deposits. — Author's abstract

Cooper, R. V. *See* Stephens, L. E. 00703

00894 **Copeland, R. A.; Frey, F. A.; Wones, D. R.** Origin of clay minerals in a Mid-Atlantic Ridge sediment: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 186-192, illus., tables, 1971.

The coarse and fine-grained mineral fractions of a Mid-Atlantic Ridge sediment (22° N.) have been separated and analyzed for Fe and rare-earth elements (REE). Despite changes in Fe abundance, all the chlorites have REE distributions consistent with derivation from ridge greenstones. The REE distribution of the fine-grained montmorillonite is similar to that of shales, yet differs markedly from that of a coarse locally derived iron-rich montmorillonite. A continental origin for the fine-grained montmorillonite is implied. — Authors' abstract

08201 **Corbel, J.; Muxart, R.** Karsts des zones tropicales humides [Karst of tropical humid zones (with English and German summaries)]: Zeitschr. Geomorphologie, v. 14, no. 4, p. 411-474, illus., tables, 1970.

This paper describes the karst zones of the tropics (especially the *humid* zones). The significance of temperature and acid organics have been overestimated; processes of dissolution are rather similar to those of other regions of *humid* Karst. The great differences of karst landscapes, often emphasized, may be explained especially by the force of *mechanical* fluvial *erosion* which is more extensive with noncalcareous material. The calcareous massifs are the most resistant against erosional process. The plateaus as well as simple buttes show marked relief. — *from* Authors' summary

08406 **Coveney, Raymond M.; Kelly, William C.** Quartz as a geologic barometer: Michigan Academician, v. 3, no. 2, p. 45-56, illus., table, 1970.

Limits of depositional temperature and pressure can be assigned to quartz formed in hydrothermal environments by pooling of data commonly obtained in conventional studies of fluid inclusions and twinning in quartz. If pressure-temperature restrictions indicated by separate study of fluid inclusions and quartz twinning are combined, new information is gained on conditions of growth. When stability fields of high and low quartz are superposed on inclusion curves, for a given inclusion of either gas-rich or liquid-rich type, the point of interest is the intersection of its isochore with the quartz inversion curve. If the quartz initially grew as low quartz, this point places an upper limit on both growth temperature and pressure. If it initially formed as high quartz, intersection points give new minimum P-T limits that are higher and more useful than those obtained by fluid inclusion study alone. — VSN

08328 **Cowen, Richard.** Analogies between the recent bivalve *Tridacna* and the fossil brachiopods Lyttoniacea and Richthofeniacea: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 8, no. 4, p. 329-344, illus., 1970.

The modern bivalve *Tridacna* has enormous size and very rapid growth, an unusual feeding mechanism, an unusual diet, and is confined to well-lit warm, shallow, tropi-

cal seas. These features are associated with presence of symbiotic Zooxanthellae within exposed tissues. Upper Paleozoic brachiopods Lyttoniacea and Richthofeniacea probably had large areas of mantle tissue exposed, were large, and can be interpreted as having had rapid growth, abnormal feeding mechanisms, and abnormal diets. They appear to be confined to shallow-water carbonate substrates, and it is suggested that they also had symbiotic Zooxanthellae. The suggestion is testable because it imposes narrow limits on environments. — *from* Author's abstract

Cox, Allan. *See* Marshall, Monte. 00874

00678 **Craig, James R.** A slide rule method for the rapid indexing of cubic X-ray powder patterns: Jour. Geol. Education, v. 19, no. 2, p. 76-78, tables, 1971.

A rapid slide rule technique employing an inverted B scale ($h^2 + k^2 + l^2$) over a normal D scale (d) permits indexing of cubic X-ray powder patterns and the determination of the unit cell dimensions. — Author's abstract

08165 **Cramer, Fritz H.; Díez de Cramer, María del Carmen.** Acritarchs from the Lower Silurian Neahga Formation, Niagara Peninsula, North America: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1077-1085, illus., 1970.

Palynomorph assemblages were extracted from 22 samples of the late Lower Silurian Neahga Formation of the Niagara Peninsula. Acritarchs are abundant and well preserved; chitinozoans are relatively rare and mostly incomplete; plant spores are absent; microfossils with leiosphere and tasmanites affinities are also abundant. Comparison of assemblage composition within the formation in either regional or chronological sense failed to show consistent, reproducible, qualitative, or quantitative differences; there are consistent quantitative composition differences between assemblages of the practically age-equivalent Maplewood and Neahga Formations. Extrapolation from biofacies boundary transgression during the Silurian, places age of the Neahga Formation at or before Elles and Wood's graptolite zone 21. — *from* Authors' abstract

08271 **Cramer, Fritz H.** Middle Silurian continental movement estimated from phytoplankton-facies transgression: Earth and Planetary Sci. Letters, v. 10, no. 1, p. 87-93, illus., 1970.

The paleolongitudinal drift of the boundaries of the *Domasia*-palynofacies during the Wenlockian was about 170 km along a cross section in North America and about 90 km in West Europe. The shift probably fixes (1) the direction of drift of the reassembled Atlantic continents during the Wenlockian as N. 45° W. ± 10° to 20°; and (2) the rest of the continental drift as 2+ cm per year. — Author's abstract

Crandall, L. Leroy. *See* Moran, D. F. 00635

00636 **Crandall, L. LeRoy.** Soils and foundations, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 186-187, illus., 1971.

Most buildings in the area of greatest damage from this earthquake are underlain by varying thicknesses of recent alluvial deposits. Bedrock motions during the earthquake were amplified several-fold resulting in much larger ground-surface accelerations and amplitudes than expected from an earthquake of M = 6.6. However, greatest damage to structures and utilities may have been caused by ruptures and fractures in the surface rather than from surface accelerations. It is apparent that lateral and vertical offsets of several feet have occurred along some ruptures in soils; rupturing occurred in an E-W direction in several belts across the northern San Fernando Valley and in the hills; it may have been from tectonic movements or may reflect permanent surface displacement from extreme ground shaking. Except in areas of ground rupturing, foundations of most buildings functioned satisfactorily. — VSN

Cressman, E. R. *See* Hrabar, S. V. 00928

08150 **Cronan, D. S.; Thomas, R. L.** Ferromanganese concretions in Lake Ontario: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1346-1349, illus., table, 1970.

A large deposit of ferromanganese oxide concretions has been found in the northern portion of Lake Ontario. The concretions occur mainly in the form of coatings on sand grains but manganese nodules are present at several localities. Mineralogically, the ferromanganese oxide phases are amorphous, and their Fe and Mn contents are similar to those in concretions from other environments. However, their Ni, Co, and Cu contents are significantly higher than those reported in previously described North American lacustrine ferromanganese concretions, and this may, in part, be a reflection of their probable low rates of accumulation. — Authors' abstract

00665 **Crosby, Gary W.** Gravity and mechanical study of the great bend in the Mexia-Talco fault zone, Texas: Jour. Geophys. Research, v. 76, no. 11, p. 2690-2705, illus., 1971.

The Mexia-Talco fault zone is one segment of a structural zone that forms the northern rim of the Gulf of Mexico basin. The zone bends abruptly by 75° in Hunt County, Texas. The near-surface position of individual faults is weakly expressed in the gravity field. The faults apparently maintain their trends into the great bend and in an alternate fashion mutually terminate against fault members of the opposite trend; however, because of the en echelon arrangement in the two segments of the zone, the change in trend of individual fault strikes is less than half that of the zone as a whole. The zone coincides with a broad 'step' anomaly. The Jurassic Louann salt apparently thins from 350 m on the Gulfward side to zero within the zone. The fault geometry is compatible with an extensional mechanical scheme wherein Mesozoic and Tertiary sediments were translated passively a short distance basinward, facilitated by long-duration salt flowage. — *from* Author's abstract

08194 **Crossman, E. J.; Harington, C. R.** Pleistocene pike, *Esox lucius*, and *Esox* sp., from the Yukon Territory and Ontario: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1130-1138, illus., table, 1970.

Two fish dentary fragments from Late Pleistocene deposits in the Old Crow area, Yukon Territory are referable to the northern pike (*Esox lucius*). One tooth fragment from the last interglacial (Sangamon) deposits in the Don River Valley, Toronto, Ontario, is identified as *Esox* sp. The Yukon dentaries are the first fossils definitely attributable to *Esox lucius* in North America, and those records are the first for the suborder Esocoidei in Canada. — Authors' abstract

00721 **Crowley, B. K.; Glenn, H. D.; Kahn, J. S.; Thomsen, J. M.** Analyses of Jorum containment: Internat. Jour. Rock Mechanics and Mining Sci., v. 8, no. 2, p. 77-96, illus., tables, 1971.

This paper describes a poineering calculational effort that dealt with problems relating to the stemming of an underground nuclear event before the event occurred. The Jorum Event presented two often-encountered situations: stemming of the main emplacement hole and of a satellite hole. This event was unusual, however, in that portions of these holes were located below the water table. One- and two-dimensional, time-dependent, finite difference calculations that solved the conservation equations, with general equations-of-state and static and dynamic frictional forces, were used to simulate the two stemming situations. The models, assumptions and parameters used in the various calculations are discussed. Even when conservative parameters were used to represent the effects of water, the calculational results indicated that the planned stemming configurations would contain the event. — Authors' abstract

08221 **Cruickshank, Michael J.** Mining and mineral recovery 1969, Chap. 2 *in* UnderSea Technology Handbook Directory 1970: Arlington, Va., Compass Publications, p. A11-A21, illus., 1970.

Milestones in development of undersea mineral resources in 1969 include formation and financing of an American company for purposes of mining manganese nodules in the deep ocean at depths to 18,000 feet, discovery and exploration of mineral

resources in many of the world's oceans by the U.S.S.R., and discoveries made during the Deep Sea Drilling Project indicating new and potentially important sources of minerals. Summaries are given in tables of world marine mineral exploration activities for 1969, recent developments in submarine sampling hardware, plants for extraction of minerals from sea water in operation 1969, selected dredging operations offshore 1969, and mining operations in consolidated deposits offshore 1969. — VSN

00715 **Csejtey, Béla, Jr.** Geologic map of the Bledsoe quadrangle, southeastern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-889, scale 1:24,000, sections, text, 1971.

Bedrock is of Devonian to Pennsylvanian age. Structure contours are drawn on the base of the Harlan coal bed. Limestone is the only mineral resource being exploited at present, although coal has been mined for local use. — ESL

00746 **Cutbill, J. L.** (editor). Data processing in biology and geology — A symposium, Cambridge, England, 1969, Proc.: London, Academic Press (Systematics Assoc. Spec. Vol., no. 3), 346 p., illus., tables, 1971.

The proceedings of the symposium on achievements and problems of data automation, held at the Department of Geology, University of Cambridge, September 24-26, 1969, include 20 papers on applications of data processing to biology and geology, three of which are cited separately. Techniques for field data recording, characterization of objects, and automation of mechanical aspects of specimen preparation and description are some of the processes of preserving data. Programming languages for data must be developed, and computer programs which can perform necessary processes must be produced. Examples are given of programs underway in institutions which handle biologic and geologic data. — EH

00867 **Cys, John M.** Origin of Capitan Formation, Guadalupe Mountains, New Mexico and Texas — Discussion (of paper by C. W. Achauer, 1969): Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 310-312, 1971.

For the paper under discussion, *see* ibid., v. 53, no. 11, p. 2314-2323, 1969; Abs. North American Geology, May 1970.

08389 **Cywin, Allen; Hendricks, Ernest L.** An overview of U.S. Department of Interior's role in sediment control, *in* National Conference on Sediment Control, Washington, D.C., 1969, Proc: Washington, D.C., U.S. Dept. Housing and Urban Development Environmental Planning Division, p. 34-40, 1970.

Concern for natural resources requires serious consideration of urban sediment problems, along with waste discharges among stream and lake. Nine USDI organizations have programs related to sediment pollution and its control, the Federal Water Pollution Control Administration and U.S. Geological Survey cooperating with State and other Federal agencies. With basic hydrologic data and broad knowledge of the water cycle and geologic processes, the USGS is probably the most active, as far as actually evaluating the effectiveness of sediment-control programs. Recently it has given attention to urban sediment problems in the growing eastern Megalopolis; results of a few cases are reviewed. Techniques for sediment control that are tailored specifically for urban or urbanizing areas must consider ecology and water quality requirements. — GDC

08209 **Dansgaard, W.; Johnsen, S. J.; Möller, J.; Langway, C. C., Jr.** Oxygen isotope analysis of a core representing a complete vertical profile of a polar ice sheet [abs.], *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 93-94, illus., 1970.

08119 **David, Peter P.** Discovery of Mazama ash in Saskatchewan, Canada [with French abs.]: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1579-1583, illus., table, 1970.

The first known Mazama ash occurrence in Saskatchewan was discovered in eolian sediments at the top of the bluffs on the South Saskatchewan River valley 20 miles (about 32 km) west of Leader, Saskatchewan. The chemical composition and the refractive index of the volcanic glass serve for the definite identification of the Mazama ash. The ash layer is a useful horizon marker in the eolian sediments, for it represents a time-break at 6,600 years ago. It is suggested that eolian deposits in similar sedimentary environments be examined for other occurrences of the Mazama ash. — Author's abstract

Davidson, D. W. *See* Horton, J. W. 00736

08392 **Davidtz, John C.; Low, Philip.** Relation between crystal-lattice configuration and swelling of montmorillonites [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 6, p. 325-332, illus., tables, 1970.

When free swelling in six Na-montmorillonites was plotted against the *b*-dimension of the clay structure, calculated from its mineralogic composition, a straight line with negative slope was obtained; a similar result was obtained with Foster's data. Free swelling plotted against the degree of tetrahedral rotation in the clay structure (calculated from mineralogic composition) resulted in a family of nearly straight lines distinguishable from each other by amount of tetrahedral Al^{3+} in clays identified with them. It is proposed that the clay surface acts as a template for the structure of the adjacent water and that, as the configuration of the surface changes, the water structure changes accordingly. This causes a change in free energy of the water and, hence, in swelling of the clay. — *from* Authors' abstract

00731 **Davies, D.** Nuclear explosions and earthquakes, Chap. 24 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 332-341, illus., tables, 1971.

The technical background for the problem of distinguishing between nuclear explosions and earthquakes is discussed under source, propagation, and receiver. In discriminating between explosions and earthquakes one goes through a chain of elimination, the principal elements of which are: location and depth of focus, first motion, complexity, and spectra of signals. Very large explosions seem to trigger something resembling aftershocks. — ESL

00832 **Davies, Geoffrey F.; Anderson, Don L.** Revised shock-wave equations for high-pressure phases of rocks and minerals: Jour. Geophys. Research, v. 76, no. 11, p. 2617-2627, illus., tables, 1971.

Shock-wave data for high-pressure phases of a number of rocks and minerals have been reanalyzed using a revised seismic equation of state to constrain the zero-pressure properties of the high-pressure phases. The anomalously low values of dK/dP resulting from a previous analysis are thereby removed. The inferred zero-pressure densities of high-pressure phases are brought into approximate agreement with the hypothesis of the molar additivity of the seismic parameter Φ. For most of the materials considered, the derived pressure trajectories of density versus Φ are consistent with shock-wave data on MgO, Al_2O_3, stishovite. In poorly constrained cases the Birch-Murnaghan equation can produce a singularity in dK/dP at high pressure. Possible crystal structures of high-pressure phases are considered using the revised zero-pressure densities. Olivines with less than about 10-mole percent FeO content may transform to a phase significantly denser than the isochemical mixture of oxides, in contrast to olivines with higher iron content. — *from* Authors' abstract

00807 **Davis, G. H.; Rollo, J. R.** Land subsidence related to decline of artesian head at Baton Rouge, Lower Mississippi Valley, U.S.A. [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 174-184, illus. [1971].

Precise leveling in the Baton Rouge area indicates as much as 30 cm subsidence of the surface during the period 1900-65. Maximum subsidence is centered in the indus-

trial district, the area of greatest withdrawals from wells and maximum decline of artesian head. Lines of equal subsidence for the period 1934-65 show a bowl-shaped depression slightly elongated east-west; the 5-cm subsidence line encloses an area of about 250 sq mi. Areal distribution of subsidence corresponds closely with distribution of decline in head in the confined aquifer system. Increases in rate of head decline in heavily pumped zones are reflected in accelerating subsidence. Presumably head decline has caused compaction of fine-grained sediments interbedded with and separating beds of water-bearing sand. Average head decline in the area of maximum subsidence approximates 200 feet since pumping of confined water began about 1890. About 0.5 ft of subsidence for each 100 feet of head decline occurs. — *from* Authors' abstract

Davis, G. L. *See* Hart, S. R. 08270

00747 **Davis, John C.** Optical processing of microporous fabrics *in* Data processing in biology and geology — A symposium, Cambridge, England, 1969, Proc.: London, Academic Press (Systematics Assoc. Spec. Vol., no. 3), p. 69-87, illus., 1971.

All information contained within a plane through a porous system can be retained and treated by optical processing techniques. Using a laser optical bench, the Fourier transform of the image of the porous system can be created at the focal point of a simple lens. In the transform, elements of the image are resolved into their spatial and angular components; relative frequency is expressed as light intensity. With proper photographic techniques, the transform can be recorded and digitized. The result is equivalent to a two-dimensional histogram of all possible traverses at all possible angles across the image. Specific components of the transform may be isolated using appropriate pass-filters. The technique is being evaluated as a method of analyzing pore structure of petroleum reservoir rocks. Studies are underway to correlate engineering properties with details of reservoir fabric. — *from* Author's abstract

Davis, Stanley N. *See* Peterson, Frank L. 00811

08188 **Dawes, Peter R.** Bedrock geology of the nunataks and semi-nunataks in Frederikshaabs Isblink area of southern West Greenland: Greenland Geol. Survey Rept. [Gronlands Geol. Undersogelse Rap., English edition] 29, 60 p., illus., tables, geol. map, 1970.

The Precambrian geology of an area within the old gneiss block of West Greenland is described. It is a gneiss-granite-amphibolite complex cut by later basic dikes. Most of the complex is folded and migmatized biotite-, hornblende-, and epidote-bearing gneisses. The oldest amphibolites occur as inclusions within the gneisses. At least six main phases of deformation can be recognized in polymetamorphic rocks. Gneisses and granites display amphibolite facies mineralogy but greenschist mineral assemblages characterize some amphibolite and ultramafic rocks. Relics of an early high-grade metamorphism, possibly reaching granulite facies, are preserved in some basic rocks. The basic dikes vary from dolerite to lamprophyre. Late tectonism and metamorphism are described. An attempt is made to place the area into the regional chronology of this part of West Greenland. — *from* Author's abstract

08354 **Dawes, Peter R.** The plutonic history of the Tasiussaq area, south Greenland, with special reference to a high-grade gneiss complex: Grönlands Geol. Undersögelse Bull., no. 88, 125 p., illus., table, geol. map, 1970; Medd. Grönland, v. 189, no. 3, 1970.

Two Precambrian rock complexes, a high-grade gneiss and a younger granitic, can be recognized in this area; both are cut by late basic dikes and faults. The gneiss complex consists of gneisses and granites with small areas of metasediments and metavolcanics displaying well-preserved primary structures; it is charnockitic with high-grade mineralogy resulting from granulite facies regional metamorphism. Three phases of migmatization post-dating early granulite facies metamorphism are recognized. A lower unit of folded and migmatized gneisses and an upper unit of relatively undeformed and unmigmatized meta-arkoses and metaconglomerates are present; meta-arkoses and conglomerates might be cover rocks to older basement gneisses or

synorogenic flysch-type deposits laid down on rocks of the same geologic cycle. The granite complex contains granites of four ages. The nature of the Precambrian evolution is considered. — *from* Author's abstract

Dawson, K. M. *See* White, William H. 08135

08247 **Day, J. H.** The classification of organic soils in Canada [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 80-84, 1970.

The National Soil Survey Committee of Canada has adopted a classification scheme for organic soils. At the first or highest level of abstraction, the Order, organic soils are defined as being saturated with water for most of the year and containing 30 percent or more of organic matter to certain depths. At the second level of abstraction, the Great Group, organic soils are differentiated on the basis of the degree of decomposition of the organic material in certain tiers or combinations of tiers. At the third level of abstraction, the Subgroup, the soils are differentiated on the occurrence of certain kinds of layers with the control section. A type name, added to the subgroup name, implies the degree of decomposition of the organic material of the surface tier. — Author's abstract

00699 **Deep Sea Drilling Project.** Deep Sea Drilling Project — Leg 15: Geotimes, v. 16, no. 4, p. 12-16, illus., 1971.

Preliminary results are reported of Leg 15 of the Deep Sea Drilling Project which was conducted in the Caribbean Sea, starting December 5, 1970, at San Juan, Puerto Rico, and ending February 2, 1971, at Cristobal, Panama. Nine sites were drilled in Venezuelan and Colombian Basins, the Cariaco Trench, on the Aves and Beata Ridges, and the Nicaragua Rise. A new engineering technique, hole reentry, was successfully used to replace worn-out drill bits. Cores from the 9 sites are described. — EH

Deer, W. A. *See* Kempe, D. R. C. 08404

Degenkolb, H. J. *See* Moran, D. F. 00635

00626 **Degenkolb, Henry J.** Preliminary structural lessons from the earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 133-134, 1971.

Strong motion records of this earthquake, taken at or near the summit of a fractured rock formation, indicate ground accelerations of more than 100 percent g horizontal and 70 percent g vertical. Recurring motions were recorded at about 50 percent g for 12 sec. The long duration of ground motions indicates that structural materials may have to undergo many more cycles of stress in the plastic range than indicated by tests and research studies. Damage caused by ground vibration as compared to permanent ground deformation should be typical of the anticipated design earthquake; however, there is no clear way of differentiating damage due to vibration from damage caused by permanent ground deformations. Five observations are made concerning building techniques and specifications to improve building response. — VSN

08268 **Den Besten, I. E.; Mancuso, J. J.** Geochemical applications of electrodelessly discharged oxygen (low temperature ashing): Chem. Geology, v. 6, no. 4, p. 245-253, table, 1970.

By application of radio-frequency discharge, oxygen gas at low pressures may be raised to excited electronic states or disassociated into oxygen atoms. The properties and some potential applications of discharged oxygen are described. Special reference is given to problems of sample preparation for elemental analysis, analysis of carbonaceous material, and microscopy using this low temperature technique. — Authors' summary

Dengo, Gabriel. *See* Bonis, Samuel. 08376

Dennen, W. H. *See* Blackburn, W. H. 00771

08377 **deRömer, H. S.** Geology of the Madeleine Nord River area, Gaspé North County: Quebec Dept. Nat. Resources Prelim. Rept. 594, 19 p., illus., tables, geol. map, 1970.

The Madeleine Nord River area lies within the northern Gaspesian segment of the eastern Appalachians and comprises 4 lithologically and structurally different units. The Shickshock Group of metavolcanic and metasedimentary rocks occupies the southwestern corner of the map area. Most of the area is underlain by the Quebec Group of metasediments and a belt of concordant meta-andesites. The western edge of the area is occupied by the eastern flank of the McGerrigle massif, a granitic batholith, dated by K-Ar determinations as Upper Devonian which intruded Lower Paleozoic rocks. The southeastern corner of the area is underlain by sandstones, limestones and siltstones of Silurian and Devonian age. Several sulfide showings occur in an alteration aureole bordering the batholith and the andesite body. Results of trace-element determinations of 242 stream sediment samples are shown on a map. — EH

Dickas, A. B. *See* Horton, J. W. 00736

00892 **Dickinson, William R.** Plate tectonic models of geosynclines: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 165-174, illus., table, 1971.

Identification of sites of miogeosynclinal and eugeosynclinal assemblages of various kinds in terms of plate tectonic theory permits interpretation of previously studied orogenic belts in terms of new global tectonics. The most important sites are elements of arc-trench systems at convergent plate junctures and miogeosynclinal settings at stable continental margins in plate interiors. Orogenic events mainly include crustal subduction and crustal collision related to plate consumption. Successions of orogenic events can be understood within the logic of plate tectonic theory. Orogenic belts record a variety of events controlled by both plate divergence and convergence. The progression of events is likely to be dissimilar in different belts even though the rock assemblages present all belong to a limited catalog of principal types. — Author's abstract

00890 **Dietz, Robert S.; Holden, John C.; Sproll, Walter P.** Geotectonic evolution and subsidence of Bahama Platform — Reply [to discussion by R. E. Sheridan of 1970 paper]: Geol. Soc. America Bull., v. 82, no. 3, p. 811-814, illus., 1971.

The paper under discussion was published in ibid., v. 81, no. 7, p. 1915-1928, 1970; Abs. North American Geology, January 1971.

Diez de Cramer, Maria del Carmen. *See* Cramer, Fritz H. 08165

00628 **Dillinger, W.; Espinosa, A. F.** Preliminary fault-plane solution for the San Fernando earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 142-149, illus., table, 1971.

A preliminary set of focal-mechanism solutions from P-wave recorded on short- and long-period seismograph systems is presented. Observed data (sense of motion, delta degrees, azimuth degrees and focal angle degrees) covering an epicentral distance range of 0.3° to 134.7° are tabulated. The procedure for finding the best fitting focal planes is incremental; two orthogonal planes are incrementally rotated through three orthogonal angles to sample the focal sphere. Solution diagrams are illustrated. Tentative interpretation favors the preliminary short-period P-wave solutions, with an E-W strike and a plane dipping south. Solution data for both long and short P-waves are tabulated. — VSN

Dobrin, M. B. *See* Fitton, J. C. 08181

00827 **Dodge, F. C. W.; Ross, D. C.** Coexisting hornblendes and biotites from granitic rocks near the San Andreas fault, California: Jour. Geology, v. 79, no. 2, p. 158-172, illus., tables, 1971.

Biotite and hornblende of quartz diorite and granodiorite near the San Andreas fault from Bodega Head to the Mojave Desert were analyzed. In eight biotite-hornblende pairs, hornblende is more oxidized than biotite. The variation in composition, and textural evidence that these two minerals crystallized later than the bulk of the feldspar and quartz, suggest that both hornblende and biotite crystallized in a system that was both unbuffered and closed with respect to oxygen. This type of crystallization, found in the Coast and Transverse Ranges, probably is due to recrystallization, and differs from the buffered crystallization of biotite and hornblende in rocks of the Sierra Nevada and elsewhere. — *from* Author's abstract

08226 **Dole, Hollis M.** General remarks, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 27-29, illus. [1970].

This paper states the needs for developing the mineral industries of the United States and especially of Alaska. It discusses scientific and technological developments in the mineral industry and how they can be applied to the growth of mineral production in the State. The role of the U.S. Geological Survey in augmenting this development is outlined. — EH

Donaldson, J. R. *See* Hacquebard, P. A. 08133

00952 **Donnay, Gabrielle; Donnay, J. D. H.; Hey, M. H.** Ewaldite, a new barium calcium carbonate — [Pt.] 1, Occurrence of ewaldite in syntactic intergrowth with mackelveyite [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., v. 15, no. 3, p. 185-200, illus., tables, 1971.

Mackelveyite type specimens are polycrystals consisting of two phases in syntactic intergrowth. One phase, for which the name mackelveyite is retained, is lime yellow, but usually shiny black due to carbonaceous inclusions. Optically biaxial, it is hexagonal and has cell dimensions reported by Milton et al. (1965), but its space group is $P6_3mc$. The other phase, to be called ewaldite, is the major constituent of the polycrystals studied by Desautels (1967) under the name mackelveyite. It is bluish-green and crystallizes in $P6_3mc$. Mackelveyite shows twinning by merohedry. Electron-probe analysis of polycrystals shows uniform concentration of major elements, indicating two crystalline forms of about the same chemical formula. Polycrystals in which ewaldite is dominant show a morphology characteristic of mackelveyite. Since mackelveyite is the more disordered structure, it goes to ewaldite by an ordering transformation. — *from* Authors' summary

00953 **Donnay, Gabrielle; Preston, H.** Ewaldite, a new barium calcium carbonate — [Pt.] 2, Its crystal structure [with German abs.]: Tschermaks Mineralog. u. Petrog. Mitt., v. 15, no. 3, p. 201-212, illus., tables, 1971.

An automated Weissenberg diffractometer was used to collect 298 symmetry-independent, absorption-corrected intensities. Least-squares refinement and difference-electron-density summations led to a residual R of 0.065. Two types of cations lie on the three-fold axes and are interleaved by carbonate groups parallel to the basal plane. The sequence of the eight layers in the cell is *ABCBACBC*. The first carbonate groups have the expected point symmetry $3m$, the second groups are occupying 1/6 of the sites of four general (12-fold) positions. The infrared spectrum is consistent with the presence of these two kinds of carbonate ions. Barium has coordination nine; calcium is six-coordinated. Polar characters of the crystal structure stems from the drastic displacement of the barium ion from midpoint between its adjacent carbonate layers toward the lower layer, containing six of the nine nearest oxygen atoms. — *from* Authors' abstract

Donnay, J. D. H. *See* Donnay, Gabrielle. 00952

00763 **Dorheim, Fred H.** The economic geology of the Iowa Devonian: Iowa Acad. Sci. Proc. 1970, v. 77, p. 257-265, illus., 1971.

Rocks of the Devonian System in Iowa crop out in a 50-mile-wide belt trending southeastward from Mason City to Muscatine. Upper Devonian rocks, except for the

Shell Rock Formation, are essentially clastic, dominantly shale; Middle Devonian rocks are dominantly carbonate; Lower Devonian rocks (not exposed in Iowa) are dominantly chert and not economically important. Middle and Upper Devonian rocks are important sources of limestone aggregate, agricultural limestone, chemical limestone, gypsum, and raw materials for cement manufacture and for the heavy ceramic industry. Devonian rocks are also used for storage of liquid petroleum gas, and are an important source of ground-water supply. Major localities and stratigraphic units are designated under each economic heading, and the future of economic development is discussed. — VMJ

00855 **Dott, Robert H., Sr.** William Eugene Ham (1916-1970): Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 531-532, portrait, 1971.

Dracup, John A. *See* Hall, Warren A. 08397

00742 **Drake, David E.; Fleischer, Peter; Kolpack, Ronald L.** Transport and deposition of flood sediment, Santa Barbara Channel, California, Chap. 5 *in* Physical, chemical and geological studies, V. 2 *of* Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970: [Los Angeles, Calif.], Univ. Southern California, Allan Hancock Found., p. 181-217, illus., tables, 1971.

The Santa Clara and Ventura Rivers contributed more than 50×10^6 tons of suspended sediment to the eastern end of the channel in the winter of 1969 during the largest recorded flood. The oxidized red color of this sediment aided in offshore tracing. Deposition of about 40×10^6 tons of flood sediment occurred on the shelf within 20 km of the river mouths. Thickness increased in the deep parts with time; after 1-1/2 years, more than 15×10^6 tons had accumulated at depths between 500-600 m. Turbid layer flow was not observed. Particle concentrations and light-transmission profiles show that movement of resuspended material westward was controlled by subsurface currents, water stratification, and topography. Gray silt layers, previously thought to be turbidites, are found to be flood-year deposits. — *from* Authors' summary

Drew, Isabella M. *See* Kerr, Paul F. 00865

00682 **Drewes, Harald.** Geologic map of the Mount Wrightson quadrangle, southeast of Tucson, Santa Cruz and Pima Counties, Arizona: U.S. Geol. Survey Misc. Geol. Inv. Map I-614, scale 1:48,000, sections, 1971.

00686 **Drewes, Harald.** Mesozoic stratigraphy of the Santa Rita Mountains, southeast of Tucson, Arizona: U.S. Geol. Survey Prof. Paper 658-C, 78 p., illus., tables, 1971.

The Mesozoic stratigraphy of the Santa Rita Mountains comprises 12 sedimentary and volcanic formations having a combined maximum thickness of more than 30,000 feet. The sedimentary rocks are mainly subaerially deposited conglomerate, arkose, and siltstone, but include some lacustrine shale and limestone and a little marine limestone. The volcanic formations are rhyolitic to andesitic pyroclastic rocks and flows, several units of which are radiogenically dated. The stratigraphic record shows that strong block faulting occurred intermittently through Triassic and may have extended into Early Cretaceous. A brief quiescent interval lasted for part of Early Cretaceous, during which the sea encroached upon the area. Sedimentary and volcanic rocks indicate that orogenic conditions prevailed during the close of the Cretaceous. — HD

Duba, Al. *See* Olinger, Bart. 00669

Duke, C. M. *See* Moran, D. F. 00635

00739 **Dutton, Carl E.** Classroom ideas — Penny as a scale, and a visual aid for structural geology: Jour. Geol. Education, v. 19, no. 2, p. 83-84, illus., 1971.

A metric scale based on the size of letters and numbers on a Lincoln penny is given. In a longer article, a shadow tray full of sand marked off for a rectangular coordinate

system with string back and forth for coordinate lines is suggested. Poker chips are pushed part way into the sand to represent outcrops, and oriented in desired strike and dip. Students plot observed data on a coordinate pattern, and made a geologic map by drawing lines to indicate distribution of each unit. The stratigraphic sequence should be shown, and a resume of the geologic history should be prepared. — ESL

08240 **Dyal, R. S.** Peat resources and activities of the United States, *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 20-21, table, 1970.

Approximately 90 percent of the peat resources of the United States are in Florida, Michigan, Minnesota, and Wisconsin, 75 percent in the latter three states. About 80 percent of the reserves occur above the 41st parallel and east of the 97th meridian, and the remainder in the Atlantic Coast region south of New Jersey. In the northern area the filled-basin type of peat consists of partially decomposed peat overlain by "-built-up" peat of mosses and shrubs. In the southern region peat deposits are in valleys and lagoons and are chiefly of salt-marsh grasses and salt-water plants. Minnesota's reserves of 6.8 billion tons are the largest in the United States. Membership of Committee D-29 on peats, mosses, humus, and related products, of the American Society for Testing and Materials, and the committee's proposed classification of peat and peat moss are given. Production figures for 1966 are included. — EH

00944 **Dyck, Willy.** The adsorption and coprecipitation of silver on hydrous oxides of iron and manganese: Canada Geol. Survey Paper 70-64, 23 p., illus., tables, 1971.

Adsorption of Ag by pure hydrous oxides of Fe and Mn in dilute solutions can be represented by Freundlich adsorption isotherms, is strongly dependent on pH, but independent of temperature in the range 0°-50°C. Adsorption and coprecipitation tests show that under identical conditions, identical amounts of Ag are incorporated by oxides; high speed of adsorption and pH dependence strongly suggest H^+ and Ag^+ ion exchange. Natural hydrous oxide precipitates adsorb much larger amounts of silver than do laboratory preparations due to ions which form insoluble compounds with silver. Igneous rocks have an average Fe:Ag ratio of 500,000 to 1 and an Mn ratio of 10,000 to 1. With indiscriminate leaching of the elements in nature, precipitation of Fe and Mn results in virtual removal of Ag from solution; hence natural waters near the neutral point cannot carry silver in solution in easily detectable quantities. — *from* Author's conclusion

00671 **Dziewonski, Adam M.** Upper mantle models from "pure-path" dispersion data: Jour. Geophys. Research, v. 76, no. 11, p. 2587-2601, illus., tables, 1971.

"Pure-path" phase and group velocities of mantle Rayleigh waves in combination with mantle Love wave velocities and worldwide averages of free oscillation data are used to derive upper mantle models with the smallest possible number of parameters. Oceanic models are characterized by a well-developed low-velocity zone. If the lithosphere is 80 km thick or less, a reversal in density distribution is necessary to explain the data. If it is 100 km thick or more, densities between 10 and 400 km can be represented by a single average value. Shield data do not require a low-velocity channel when velocity in the lid is 4.60 kmps or less, but do require one for higher S_n velocities. The characteristic feature of tectonic models is high shear velocity between 200 and 400 km (> 4.8 kmps), and could be explained by thrust of oceanic lithosphere under tectonic regions. — DBV

Echevarria, G. *See* Levchenko, V. A. 00773

Edgar, A. D. *See* Piotrowski, J. M. 08352

Edge, R. A. *See* Macdonald, Raymond. 08218

08153 **Egbert, R. L.; Armstrong, E. F.** The use of computer prepared residual maps as an aid in determining sedimentary environments of the Muddy Formation, northeastern Wyoming: Mtn. Geologist, v. 7, no. 4, p. 253-268, illus., 1970.

Residual maps of subsurface structural or isopach data can now be computed rapidly, accurately, and easily by means of the electronic digital computer. This paper describes the preparation of residual maps by both manual and machine methods. The computation of residual maps for paleoenvironmental analysis from isopachous intervals of the Lower Cretaceous Muddy Sandstone and related rocks in the northern Powder River basin, Wyoming, are discussed as an example. The geometry of the individual units in the sandstone, as depicted by the computer prepared residual maps, is used in assigning specific environmental designations which are of particular use in predicting sand petroleum reservoir conditions. Isopachous residual maps of the various units in the Muddy Sandstone are illustrated. — VSN

Ehlers, Ernest G. *See* McLachlan, Dan, Jr. 00660

08306 **Ehlers, George M.; Kesling, Robert V.** (compilers). Devonian strata of Alpena and Presque Isle Counties, Michigan, *in* Guidebook for field trips — Geol. Soc. America North-Central Sec., May 1970: [East Lansing, Mich.], Michigan Basin Geol. Soc., p. 1-30, illus., tables, 1970.

Presented, with sections on pre-Traverse formations and Traverse Group Formations, are an updated list of localities, rock sections, and faunal lists, well illustrated. Described briefly are various features to be seen in type localities and composite sections. Faunas are still incompletely known, and taxonomic revisions are overdue for some groups. Depositional environments and stratigraphic relations are indicated, as well as conditions of erosion. Sketch maps show some revision of data from previous workers, made in the course of recent field work, and summarize findings over many years. — GDC

00866 **Eljpe, R.; Weber, K. J.** Mini-permeameters for consolidated rock and unconsolidated sand: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 307-309, illus., 1971.

A small instrument has been developed for the rapid nondestructive measurement of air permeability. It can be used on consolidated and unconsolidated material either *in situ* or in the form of samples. The permeability measured is an average for the 1 cm-diameter circular area surrounding the tip. One measurement usually takes less than a minute. — Authors' abstract

00639 **Eisbacher, G. H.; Bielenstein, H. U.** Elastic strain recovery in Proterozoic rocks near Elliot Lake, Ontario: Jour. Geophys. Research, v. 76, no. 8, p. 2012-2021, illus., table, 1971.

Elastic strain recovery in boreholes was measured in underground mines near Elliot Lake, Ontario, Canada. Maximum elastic strain recovery is horizontal and parallel to the local postorogenic joint sets. Close to the mine workings this relationship is disturbed by the stress field induced by mining. The magnitude of the stress tensor increases with depth. The *in situ* stresses are interpreted as remanent tectonic stresses that were imprinted onto the rock during the Hudsonian orogeny (1,700 m.y. ago). Unloading and reorientation of the stresses was achieved by long-lived arching along an easterly trending axis. A parallelism of maximum elastic strain recovery (maximum compressive stress) and axes of regional arching in eastern North America is inferred from available data. — Authors' abstract

00707 **Eisbacher, G. H.** Contemporaneous faulting and clastic intrusions in the Quirke Lake Group, Elliot Lake, Ontario — Reply [to 1971 discussion by J. A. Robertson of 1970 paper]: Canadian Jour. Earth Sci., v. 8, no. 2, p. 308, 1971.

The paper under discussion was published in ibid., v. 7, no. 2, p. 215-225, 1970; Abs. North American Geology, September 1971; discussion by Robertson, ibid., v. 8, no. 2, p. 307-308, 1970; Abs. North American Geology, this issue.

Eittreim, S. *See* LePichon, Xavier. 00750

Eldredge, Niles. *See* Rollins, Harold B. 00946

00834 **Elias, Maxim K.** Concept of common bud and related phenomena in Bryozoa: Kansas Univ. Paleont. Contr. — Paper 52, 21 p., illus., 1971.

The common bud of Stenolaemata (=Cyclostomata) of Borg (1926), is analogous to the buds of higher plants in its position and activities. It is common to all developing zooecia in a branch of a zoarium, its coelomic fluid remaining undivided distally as long as long as the branch grows. All polypide buds originate at the edge of a transverse membrane that seals the coelomic fluid terminally; as the branch grows, the polypide, now separated by an oblique septum, falls behind the growing edge of the membrane, the growing zone of Borg, analogous to the meristem of plants. Walls and septa of a zoarium with a common bud combine their calcareous layers into the colonial plexus (Elias and Condra, 1957). Cheilostomata lack common buds, but in *Membranipora* each contiguous row of zooecia has its terminal linear bud (new term) with its own growing zone. The Ordovician "graptolite" *Reticulograptus* is probably a stenolaemate. — VMJ

Ellis, R. M. *See* Jensen, O. G. 08137

08402 **Emery, K. O.** Continental margins of the world [with French and German abs.], *in* The geology of the East Atlantic continental margin — ICSU/SCOR Working Party 31 Symposium, Cambridge, England, 1970, [Pt.] 1, General and Economic Papers: [Great Britain] Inst. Geol. Sci. Rept., no. 70-13, p. 3-29, illus., 1970.

Sediments of most continental shelves are retained by tectonic or reef dams; those of other shelves are held by the angle of rest of the adjacent continental slope. Continental rises at the base of the slopes are huge masses of sediment deposited by turbidity currents and the sinking of pelagic debris; some of them subsequently are modified by mass movements and bottom currents. Rises occur only where the continental margins lie within crustal plates; they are absent where deep-sea trenches mark zones of convergence at the edges of crustal plates. In the Atlantic Ocean the continental margins date from Permian-Triassic times when the rifting between continents began. — Author's abstract

00961 **Emiliani, Cesare.** Climate cycles: Sea Frontiers, v. 17, no. 2, p. 108-120, illus., 1971.

This review of climatic cycles of the present and the past describes how past cycles are known from historical records and geological or paleontological observations. — EH

Emslie, R. F. *See* Roeder, P. L. 08276

Engdahl, E. R. *See* Espinosa, A. F. 00627

Engen, G. R. *See* Allen, C. R. 00608

08302 **Eschman, Donald F.; Farrand, William R.** Glacial history of the Glacial Grand Valley, *in* Guidebook for field trips — Geol. Soc. America North-Central Sec., May 1970: [East Lansing, Mich.], Michigan Basin Geol. Soc., p. 131-158, illus., tables, 1970.

This late-glacial outlet for Huron-Erie proglacial lakes, connecting the Saginaw and Michigan basins, may be the best means of correlating Pleistocene events on both sides of the Michigan Peninsula. The amazingly straight valley, except for one large S-curve in the Grand Rapids area, averages half a mile in width, its sides rising abruptly some 150 feet above the floor. The present gradient of less than a foot per mile is about the same as earlier. Complications in its history are indicated by features seen on this field trip: terraces along the valley length, some capped by tributary fans, mid-channel highs; abandoned channels south and west of Grand Rapids that functioned while Lake Michigan ice lobe blocked drainage into Lake Chicago near Allendale. Sketch maps show moraine relations. Attention is drawn to problems raised by current studies. — GDC

00627 **Espinosa, A. F.; Engdahl, E. R.; Tarr, A. C.; Brockman, S.** A preliminary report of near-field seismic monitoring of the San Fernando earthquake aftershock series, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 135-141, illus., 1971.

Within 24 hours after the San Fernando earthquake a continuously recording tripartite array was established in the San Gabriel Mountains to monitor aftershocks. Instrumentation consisted of a short-period vertical seismometer recording on smoked paper, and higher-gain, multilevel, three-component seismometers recording on magnetic tape. Near-field instrumentation consisted of self-contained, short-period seismometers recording on magnetic tape. Most recorded aftershocks were in the 2.0 to 3.0 magnitude range. On the basis of frequency of aftershocks, the zone of activity was closest to station SCF at 34°26.0′ N., 118°17.3′ W. Frequency of events fell rapidly from 45 per hour on Feb. 10 to 6 per hour on Feb. 15. Records at Station LSM at Little Skull Mtn., Nev., are discussed also. — VSN

Espinosa, A. F. *See* Dillinger, W. 00628

Estabrook, G. *See* Andrews, J. T. 00829

08151 **Evans, Robert.** Sedimentation of the Mississippian evaporites of the Maritimes, an alternative model: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1349-1352, tables, 1970.

Recent work on the carbonates and sulfates of the Mississippian Windsorian rocks of the Maritime Provinces has led to the idea that the widespread evaporites in the area are the product of sedimentation in supratidal flats and in depressions in those flats. The tectonic setting and lithologic features of the more soluble evaporites, however, suggest a comparison with the Plio-Pleistocene sediments of the Dead Sea graben, and it is proposed that the great thicknesses of chlorides known to exist in Nova Scotia and New Brunswick are the result of rapid sedimentation in possibly deep water within the Fundy Rift formed at the end of the Acadian Orogeny. — Author's abstract

00801 **Everett, Duane E.** Hydrologic and quality characteristics of the lower Mississippi River: Louisiana Dept. of Public Works — In cooperation with U.S. Geol. Survey Tech. Rept. No. 5, 48 p., illus., tables, 1971.

Average daily flow of the Mississippi River at Vicksburg is 551,100 cfs and average annual suspended-sediment load is 750,000 tons per day. Sediment concentrations at Red River Landing range from about 10 to 2,500 mgl. Concentration of dissolved solids ranges from about 150-340 mgl but is generally less than 300 mgl. Below Batin Rouge mineralization increases greatly especially during low-flood periods. Constant salt-water intrusion from the Gulf of Mexico becomes a problem upstream when river discharge is low. Water temperature in the lower part of the river is generally 28°C or less. Discharge of domestic sewage causes high bacterial concentrations. — *from* Author's abstract

08309 **Evitt, William R.** Dinoflagellates — A selective review, *in* Perkins, B. F., editor, Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, p. 29-45, illus., tables, 1970.

A brief history of the investigation of fossil dinoflagellates and a summary of certain biological considerations are followed by a survey of recent progress along selected lines in the study of these organisms. Some of the new information that has come to light as a result of the reinforcing interplay between biological and paleontological investigation is reviewed, and some of the nomenclatural and taxonomic questions raised by it, which will concern students of living and fossil dinoflagellates alike, are pointed out. Morphological features that distinguish theca from resting cyst and the requisite for an adequate description of the resting cyst are tabulated. An extensive bibliography includes detailed papers on the topics covered. — Author's abstract

Ewing, John I. *See* LePichon, Xavier. 00750

Fairbridge, Rhodes W. *See* Richards, Horace G. 08190

08338 **Fairhurst, C.** Borehole methods of stress determination [with French and German abs.], *in* International Symposium on Rock Mechanics [2d], Madrid, 1968, Proc.: Madrid, Spain, Soc. Española de Mecánica de Rocas, p. 273-279, illus., 1970.

Limitations of borehole methods of stress determination are discussed and it is shown that interpretation of results is the principal source of error. The stress relief method is largely dependent on the assumed behavior of rock and an error of 100 percent or more is possible if isotropy is assumed in estimating stresses in transversely isotropic material. Ignoring the influence of axial stress in the 'doorstopper' method can introduce appreciable errors, as well as any variation in rock properties in the vicinity of the hole. High modulus inclusions are very valuable in elastic rocks and for determination of stress changes in rocks undergoing creep. Some information is presented about hydraulics pressurization cells with the fracturing technique used in the petroleum industry, a promising method for testing rocks at great depths. — *from* Author's abstract

Farnham, R. S. *See* Finney, H. R. 08250

Farrand, William R. *See* Eschman, Donald F. 08302

Farvolden, R. N. *See* Hughes, G. M. 00822

Faure, G. *See* Fenton, M. D. 08154

Faure, G. *See* Fenton, M. D. 08155

00963 **Felix, D. W.; Gorsline, D. S.** Newport Submarine Canyon, California — An example of the effects of shifting loci of sand supply upon canyon position: Marine Geology, v. 10, no. 3, p. 177-198, table, 1971.

Newport Submarine Canyon off Newport Beach, Calif., a typical small shelf canyon, has formed at a point where the shelf is narrow and sand is concentrated at a convergence zone. The present topographic expression of the canyon represents its most recent position which is being abandoned due to shifts in loci of sand input. Changes in location of the mouth of the Santa Ana River, the principal sand source, have shifted the point of longshore drift and sand concentration about 1 km northwest of the present canyon head which is gradually being filled only with fine organic-rich sediments. Sand deposition is being distributed as a lobe over the shelf north of the canyon. The locale illustrates the process of canyon origin, development, and abandonment. Evidence suggests that the cycle also occurred in Holocene and Late Pleistocene time and that the canyon has shifted laterally several times in response to the changing point of sand input. — *from* Authors' abstract

08154 **Fenton, M. D.; Faure, G.** Rb-Sr whole-rock age determinations of the Iron Hill and McClure Mountain carbonatite-alkalic complexes, Colorado: Mtn. Geologist, v. 7, no. 4, p. 269-275, illus., tables, 1970.

The Rb-Sr whole-rock method has been used to measure the ages of two alkalic intrusions and related carbonatites in Colorado — the Iron Hill complex in Gunnison County, and the McClure Mountain complex in Fremont County. The age and initial Sr-87/Sr-86 ratio of the Iron Hill complex are 1487 ± 9 m.y. and 0.7027, respectively. Two isochrons define the limits of age and initial Sr-87/Sr-86 ratio for the McClure Mountain complex as 517-704 m.y. and 0.7055-0.7059. — Authors' abstract

08155 **Fenton, M. D.; Faure, G.** A Rb-Sr whole-rock age determination for the Rainy Creek alkalic-ultramafic complex, Montana: Mtn. Geologist, v. 7, no. 4, p. 277-280, illus., tables, 1970.

Rb-Sr analyses of four whole rocks and one biotite separate from the Rainy Creek complex near Libby, Montana, indicate an age of 184 ± 3 m.y. and an initial Sr-87/Sr-86 ratio of 0.7038 ± 0.0002. — Authors' abstract

08186 **Ferguson, Carl C.; Garman, R. Keith.** Mineral resources summary of the Buchanan quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 7 p., tables, 1970.

This summary accompanies the geologic map of the Tennessee part of the Buchanan quadrangle, GM 19-NW, by Keith R. Garman and Carl C. Ferguson. Mineral resources that have been mined are gravel and sand, with clay and heavy minerals as potential resources. — ESL

08187 **Ferguson, Carl C.** Mineral resources summary of the Huntingdon Quadrangle, Tennessee: Nashville, Tenn., Tennessee Div. Geology, 26 p., illus., tables, 1970.

This summary accompanies the geologic map of the Huntingdon quadrangle, GM 9-SW, in northern Carroll County. The only mineral resource that has been mined is clay; a potential resource is sand. Locations of clay pits, prospects, and drill holes, and analyses, physical characteristics, and test results of various clays are tabulated and discussed briefly. — VSN

08326 **Ferguson, Carl C.** Geologic map of the Huntingdon quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 9-SW, scale 1:24,000, separate text, 1970.

Ferguson, Carl C. *See* Garman, R. Keith. 08357

08292 **Ferguson, John.** On the schistose structure of some lujavrites: Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 67-68, 1970.

The author reviews data on the lujavrites of Ilímaussaq, South Greenland. He concludes that "recent experiments show that the difference between liquidus and solidus temperatures for green lujavrite from Ilímaussaq measured 500°C at 1 atm and 450°C at $PH_2O = 1$ Kb, the solidus temperature at the latter pressure being 430°C. The considerably extended melting intervals of agpaitic rocks explains the great thickness of lujavritic crystal mush necessary for the development of the schistose fabric displayed by some of these rocks." — EH

00755 **Fertl, Walter H.; Timko, Donald J.** A distinction of oil and gas in clean and shaly sands as derived from well logs: Log Analyst, v. 12, no. 2, p. 25-32, illus., table, 1971.

Qualitative detection of hydrocarbons, distinction of oil and gas, and estimation of hydrocarbon density in clean and, under favorable conditions, in shaly pay sands is possible by overlay techniques of comparable scale logs or simple cross-plot techniques. These methods allow a quick evaluation at the rig site and assist in proper depth selections for test and completion operations. — Authors' conclusions

08250 **Finney, H. R.; Farnham, R. S.** Mineralogy of the inorganic fraction of peat from two raised bogs in northern Minnesota [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 102-108, illus., tables, 1970.

The inorganic fraction was removed from peat by oxidation, the soluble portion was removed, and the insoluble material was separated into various particle-size fractions which were examined by petrographic and X-ray diffraction techniques. Material <2 μ comprised about 45 percent, 2-6 μ about 15 percent, 6-20 μ about 30 percent, and >20 μ about 10 percent. Quartz and feldspar were common in the >2 μ fractions in all layers of peat, but in some, opal was dominant, comprising up to 45 percent. The opal was mostly of biological origin and was derived primarily from grasses. The <2 μ fraction contained kaolinite, illite, vermiculite, quartz, and feldspar. It was concluded that most minerals in the peat were transported there by wind from prairie areas to the west. Further, those layers that contained small amounts of opal formed before the prairies became fully established. — *from* Authors' abstract

Fireman, E. L. *See* McCorkell, R. H. 08210

Fireman, E. L. *See* McCorkell, R. H. 08214

Fisher, George W. *See* Higgins, Michael W. 00884

Fishman, M. J. *See* Brown, Eugene. 08199

Fiske, Richard S. *See* Wright, Thomas L. 00733

08181 **Fitton, J. C.; Dobrin, M. B.** An evaluation of optical processing based on experience with seismic data: Geocom Bull., v. 3, no. 10, p. 184-196, illus., 1970; reprinted from Bendix Tech. Jour., v. 2, no. 2, p. 25-38, 1969.

The Laser Scan optical processing system has been used for over 5 years in analyzing and filtering seismic data as well as experimentally. Although this system, based on Abbe's principles, is suited to the study of geophysical and other data, its acceptance as a routine processing tool has been slowed by practical problems, many of which can be resolved by present technology. These problems and their solutions are described in the light of experience with the Laser Scan system, particularly as applied to processing of data obtained by the seismic method. Limitations in photographic processes and the optical system, and problems of the design and application of optical filters are discussed. Subjective attitudes are of great importance in processing and final acceptance of results.—*from* Authors' abstract

08349 **Fleischer, Michael.** Some possible new minerals not yet found: Mineralog. Rec., v. 1, no. 3, p. 121-123, tables, 1970.

Listing of possible new minerals may be based, for instance, on laboratory-prepared compounds that might be reasonably expected in Nature, but not yet reported, or, from published lists of minerals, on simple substitutions of one element by another of similar ionic radius. Typical examples are listed, along with some recently described minerals that show the same substitution; a single entry gives double replacements commonly found in complex silicates and oxides. Degree of probability for such compounds is influenced by: effects in different geological environments of availability of elements (especially rare Ge and Ti); competition for them by other compounds; relative solubilities of compounds; and crystal structure. Diversity of possible natural environments and the remarkable natural concentrations of elements make prediction of new minerals a hazardous hobby. — GDC

Fleischer, Peter. *See* Drake, David E. 00742

08342 **Floyd, E. O.; Long, A. T.** Well records and other basic ground-water data, Craven County, North Carolina: North Carolina Div. Ground Water Ground-Water Circ. 14, 104 p., illus., tables, 1970.

Basic data are reported that were collected during an investigation in Craven County of the character, areal extent, depth, and thickness of water-bearing formations; of the storage and transmissibility properties of the formations; and of the chemical quality of the ground water. Water-bearing sediments are sand and limestone, alternating with beds of clay, and are all typical of coastal plain sediments. Data are presented in tabular and graphic form and include records of 456 wells, chemical analyses of 254 water samples, lithologic logs of 123 wells, and hydrographs of 5 wells. Aquifer characteristics are given in a table previously published in U.S. Geol. Survey Hydrologic Inv. Atlas 343 (Floyd, 1969). — VSN

Ford, Derek C. *See* Pluhar, Agnes. 08203

08373 **Forstén, Ann.** *Mesohippus* from the Chadron of South Dakota, and a comparison with Brulean *Mesohippus bairdii* Leidy: Soc. Sci. Fennica Commentationes Biol., v. 31, 1967-70, no. 11, 22 p., tables, 1970.

Samples of cheek teeth of *Mesohippus* from the three members of the Chadron [Formation] are compared. The material indicates occurrence of two species, differing in size. In the smaller, more common form are some trendlike changes in morphology and proportions of the teeth and between tooth categories. In comparing the three samples of the small Chadron mesohippus with a large sample of Lower Brulean *Mesohippus bairdii*, close similarity was observed between the latter and the sample from the Peanut Peak member (Upper Chadron). Samples of mesohippus from the Crazy Johnson (Middle Chadron) and Ahearn (Lower Chadron) members are

slightly different, but all close enough to be considered as belonging to species *M. bairdii*. The primitive morphology of the Lower Chadronian form warrants subspecific separation. The large mesohippus of the Chadron is identified with *M. proteulophus*. — *from* Author's abstract

Fowler, Lowell W. *See* Burgat, Virgil A. 08414

Franconi, A. *See* Wynne-Edwards, H. R. 08121

08381 **Frank, J. F.; Johnson, Nyra A.** Selected ground-water data in the Eugene-Springfield area, southern Willamette Valley, Oregon: Oregon State Engineer Ground Water Rept. 14, 70 p., illus., tables, 1970.

This hydrologic study of the Eugene-Springfield area of Oregon was made by the U.S. Geological Survey in cooperation with the office of the Oregon State Engineer. The report presents basic records of representative wells and springs, water levels and chemical quality of the ground water in the area. It contains data that will not be included in the final report planned for publication as a U.S. Geological Survey Water-Supply Paper. — EH

Fredericksen, Walter F. *See* Burgat, Virgil A. 08414

00651 **Freeze, R. Allan.** Three-dimensional, transient, saturated-unsaturated flow in a groundwater basin: Water Resources Research, v. 7, no. 2, p. 347-366, illus., 1971.

A three-dimensional finite difference model has been developed for the treatment of saturated-unsaturated transient flow in small nonhomogeneous, anisotropic geologic basins. Its uniqueness is inclusion of the unsaturated zone in a basin wide model that can also handle both confined and unconfined saturated aquifers, and natural and developed conditions. The integrated equation of flow is solved by the line successive overrelaxation technique. When applied to natural flow systems, the model provides quantitative hydrographs of surface infiltration, ground-water recharge, water-table depth, and stream base flow. Simulations for hypothetical basins provide insight into mechanisms in development of perched water tables. The unsaturated basin response is identified as the controlling factor in determining nature of the base flow hydrograph. — *from* Author's abstract

00759 **French, Bevan M.** Possible relations between meteorite impact and igneous petrogenesis, as indicated by the Sudbury structure, Ontario, Canada: Bull. Volcanol., v. 34, no. 2, p. 466-517, illus., 1971.

The recent discovery of shock-metamorphic features in rocks of the Sudbury structure indicates that this old and complex structure was produced by impact of a large meteorite. Grades of progressive shock metamorphism comparable to those recognized at younger impact structures have been established. The inferred development of the structure was a complex process involving: (1) impact of an asteroidal body, forming a 100-km-wide crater with central uplift; (2) subsidence of the central uplift and simultaneous emplacement of the Nickel Irruptive; (3) metamorphism, deformation, and erosion. Similar structures probably exist on both Earth and Moon. Examination of roofed lopoliths and ring-dike structures for shock-metamorphic effects, combined with consideration of geophysical effects of high-energy impacts, should be a productive field for cooperative studies by astrogeologists and igneous petrologists. — DBV

Frey, F. A. *See* Copeland, R. A. 00894

08408 **Frey, M. G.; Grimes, W. H.** Bay Marchand-Timbalier Bay-Caillou Island salt complex, Louisiana, *in* Geology of giant petroleum fields — Symposium, AAPG, 53d Ann. Mtg., Oklahoma City, Okla., 1968: Am. Assoc. Petroleum Geologists Mem. 14, p. 277-291, illus., table, 1970.

The Bay Marchand-Timbalier Bay-Caillou Island salt complex, more than 28 mi long and up to 12 mi wide, may be part of a much longer salt feature that extends both east

and west. The mother salt bed, of probable Late Triassic-Early Jurassic age, is now buried to depths of 40,000-50,000 feet; tops of the individual domes along the trend are within 2,000-3,000 feet of the surface. Production to date on this three-field complex has exceeded 0.7 billion bbl of oil; estimated reserves range from another 0.75 billion to 1 billion bbl. In addition, significant gas reserves are present. Hydrocarbon accumulations are in sands of Pleistocene through late Miocene age and range in depth from 1,000 to more than 20,000 feet. A wide variety of traps include supradomal arching, shale and salt truncations, stratigraphic traps, and traps resulting from faults. Production was established on the complex in 1933; total for 1967 was approximately 97 million bbl. — *from* Authors' abstract

Frost, Robert E. *See* Rinker, Jack N. 08236

08160 **Gabelman, J. W.** Metallotectonic control of uranium distribution, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 187-204, incl. discussion, illus., 1970.

Zoning of metal deposits around alteration centers distinguishes mineral districts of certain ranges of temperature. Grouping of districts into linear regional zones in temperature-paragenetic sequence establishes regional zoning and a mineralization temperature-intensity gradient across zones. Mineral zones are coextensive with zones of deformation intensity in circumcontinental mobile belts. Each phase of the tectonic cycle is capable of generating a mineralization cycle, and heat of shallow orogeny can turn ground fluids into hydrothermal fluids. Taphrogeny, in hinterlands from which low-temperature elements have been flushed, involves deep faults that may tap the mantle and introduce new elements. Uranium is most stable in lowest temperature environments so seeks a place at the extreme foreland end of mineralization gradients. The consistency of this relation in mobile belts in the Americas, justifies extension to mobile belts of any age. — *from* Author's abstract

08163 **Gabelman, J. W.** Speculations on the uranium ore fluid, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 315-330, incl. discussions, tables, 1970.

Uranium mineralization occurs in geographically restricted areas, concentrated along forelands of mobile belts, but source rocks are in the hinterland. Districts in regionally extensive formations are localized in relation to broad tectonic features. The areally uniform uranium content of most source rocks indicates resistance to leaching by ordinary water. Patterns of altered rock accompanying uranium deposits do not reflect fresh-water flow, but are restricted, indicating a limited supply. Brines have concentrations of uranium-deposit elements many times more than levels in source rocks. Fluid-gas inclusions in calcite from uranium deposits appear to be brines trapped at 45 to 65°C. The ore fluid could be a brine composed of originally meteoric water enriched in mineral ions by percolation through heated environments, and migrating and mineralizing in response to temperature zoning. — *from* Author's abstract

00861 **Gabrysch, Robert K.** Land-surface subsidence in the Houston-Galveston region, Texas [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 43-54, illus., table [1971].

In the Houston-Galveston region, the principal cause of land-surface subsidence is the lowering of pressure heads due to the removal of water and oil from subsurface strata. The region is underlain by a thick section of unconsolidated lenticular deposits of sand and clay. Clays separating beds of sand retard vertical movement of water, thus creating artesian conditions within aquifers. The ratio of sand to clay, a major factor controlling degree of compaction, varies from place to place in the aquifers. Reduction of pressure due to withdrawal of water causes additional load to be transferred to the skeleton of the aquifer system, thus causing compaction. As much as 5 feet of subsidence has occurred in the region between 1943 and 1964, and as much as 200 feet of water-level decline. The rate of subsidence increased from about 0.2 ft per year during 1954-59 to about 0.24 ft per year during 1959-64. The

decline in water levels increased from about 4 ft per year to about 7 ft per year in those same periods. — *from* Author's abstract

00945 **Galusha, Ted; Blick, John C.** Stratigraphy of the Santa Fe Group, New Mexico: Am. Mus. Nat. History Bull., v. 144, art. 1, illus., tables, geol. map, 1971.

This report restricts the Santa Fe Group to rocks of the type and contiguous area north of Santa Fe and between the Sangre de Cristo Mts. on the east and the Jemez Mts. on the west as designated by Denny (1938, 1940). Middle Miocene to middle to upper Pliocene deposits of this area are divided between the older Tesuque Formation with five members and the younger Chamita Formation. Formal names are designated for Tesuque Formation members, members are described, and type sections are indicated. Beds of the Chamita Formation contain fossil mammals showing them to be mid to late Pliocene in age; type section of this formation is 2 miles northwest of San Juan Pueblo. Total thickness of the Santa Fe Group is at least 4500 feet; it contains alluvial-fan and eolian deposits with volcanic ash, bentonite, tuffs, and a few small volcanic flows. Structural history of the Rio Grande depression is discussed. — VSN

Gard, L. M. *See* Carr, W. J. 00879

00776 **Garland, John H.** Water supply for domestic and industrial uses, Chap. 9 *in* Conservation of Natural Resources (Guy-Harold Smith, editor): New York, John Wiley and Sons, p. 221-239, illus., 1971.

The problem of water conservation cannot be independent of other natural resources, nor is its restriction a solution. Total volume will always depend on precipitation; available water depends upon flyoff, runoff, and cutoff, or the relation of evaporation, surface drainage, and ground water. A proper balance, maintained by adequate reforestation and soil conservation programs, can ensure a source of water for all but the most fantastic demands. If only 1 percent of the 70 percent evaporated from other than irrigated land were saved, needs of present metropolitan regions would be met. Open reservoirs are wasteful unless protected by evaporation covers; underground storage, recharge by surface waters through dry wells, reduction of pollution, purification and re-use of water are necessary. Much progress has been made in desalinization of both sea water and salty ground water, but amount usable is not great. Waste disposal practices must not contaminate water supplies. — GDC

Garman, R. Keith. *See* Ferguson, Carl C. 08186

08357 **Garman, R. Keith; Ferguson, Carl C.** Geologic map of the Buchanan quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 19-NW, scale 1:24,000, separate text, 1970.

Gastner, Manfred. *See* Milliman, John D. 00875

08370 **Gates, J. S.; Keller, O. A.** Ground water in Tooele Valley, Utah: Utah Dept. Nat. Resources Water Circ., no. 2, 15 p., illus., table, 1970.

This report is a condensation of parts of a technical report on ground water in Tooele Valley by J. S. Gates entitled "Reevaluation of the ground-water resources of Tooele Valley, Utah": Utah State Engineer Tech. Pub. 12, 68 p., illus., tables, 1965; *see* Abs. North American Geology, February 1966. The nine chapters of the short version discuss: what is ground water,; the ground-water reservoir in Tooele Valley; where the water comes from; how water enters, moves through, and leaves the reservoir; amount of water stored in the reservoir; chemical quality of the water; and are we using too much ground water?– VSN

Gauri, K. Lal. *See* Boucot, Arthur J. 08184

08368 **Gerlach, Arch C.** Pan American Institute of Geography and History, PAIGH: Organization Am. States Specialized Organizations Pub., no. 315, 73 p., 1970.

The history, organization, objectives and functions, activities and accomplishments, and plans for the future of the Pan American Institute of Geography and History are summarized briefly, followed by the organic statutes and a catalog of publications of PAIGH. The objectives of the institute are to encourage, coordinate, and publicize cartographic, geophysical, geographical, historical, and related scientific studies of interest to the Americas; to promote and carry out studies, work, and training in the above fields; and to promote cooperation among organizations interested in these fields in the Americas with related international organizations. — VSN

Ghent, E. D. *See* Macqueen, R. W. 08145

Gibbs, J. F. *See* Wesson, R. L. 00609

Gierman, G. *See* Revelle, R. 08382

00925 **Giese, R. F., Jr.** Hydroxyl orientation in muscovite as indicated by electrostatic energy calculations: Science, v. 172, no. 3980, p. 263-264, table, 1971.

The electrostatic energy of the $2M_1$ muscovite structure has been calculated as a function of the orientation of the hydroxyl group. The minimum in the electrostatic energy occurs when the O-H bond makes an angle of 18° with the cleavage plane and an angle of 31° with the b-axis (in the a-b plane), which is 2.5° away from the orientation of the transition moment as determined from infrared measurements on single crystals. If the K^+ ion is excluded from the calculation, the O-H bond makes an angle of 53° with the cleavage plane. This indicates the strong influence that the interlayer cation exerts on the hydroxyl hydrogen in mica structures. — *from* Author's abstract

00891 **Giletti, Bruno J.** Discordant isotopic ages and excess argon in biotites: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 157-164, illus., tables, 1971.

Major isotopic age discordances are found at the eastern margin of a terrane in SW Montana metamorphosed 1.6 AE ago (1 AE = 10^9 years). In Portal Creek, a one-mile portion of a traverse across this margin yields: discordant whole rock Rb-Sr ages which approximate 2.8 AE; seven biotite Rb-Sr ages concordant at 1.68 AE; 15 biotite highly ciscordant K-Ar ages, ranging from 1.63 to 3.25 AE; 10 concordant hornblende K-Ar ages at 1.9 AE. It is concluded that there was a major resetting event for the hornblendes at 1.9 AE ago. This was followed by a milder (,) event at 1.6 AE when biotites became open systems while hornblende did not. During this time, biotites lost all radiogenic Sr-87, but gained radiogenic Ar-40 up to 16.0×10^{-4} scc Ar/g biotite. There is evidence of incorporation of Sr-87 into minor amphibolitic layers in these quartzo-feldspathic rocks. — *from* Author's abstract

00754 **Gill, James A.; Weintritt, Donald J.** Shale factor — A diagnostic tool for formation logging: Log Analyst, v. 12, no. 2, p. 14-24, illus., table, 1971.

A new, rapid logging method has been developed to describe precisely, by a 'shale factor' number, the nature of formations penetrated. This technique is based on determination of clay content or 'shaliness' of a sand/shale sample with a standard methylene blue dye. Plots of shale factor made at the wellsite during drilling are used to assist in pressure detection for balanced pressure drilling, and shale factor logs have been used to locate formations that cause severe borehole instability. An important advantage in use of the shale factor is that it takes the guess work out of lithology determination by giving a more precise number for shaliness/sandiness of a formation; results sometimes contradict previously determined lithology. — VSN

Glenn, H. D. *See* Crowley, B. K. 00721

08416 **Globensky, Yvon.** Arenaceous foraminifera from the Windsor Group (Middle and Upper Mississippian) of the Atlantic Provinces of Canada: Canadian Jour. Earth Sci., v. 7, no. 3, p. 768-785, illus., tables, 1970.

From the arenaceous foraminifera fauna of the Windsor Group, 10 genera and 27 species are identified, of which 5 species are new. Locally, the different subzones of

the group are characterized by species that have restricted ranges. *Reophax* and species are restricted to Subzone B. These arenaceous foraminifera appear to be the first indication of the extensions in their ranges to the Middle and maybe to Upper Mississippian. This is the first detailed report on the arenaceous foraminifera in the Windsor Group and is an important aid in correlating Middle and Upper Mississippian strata of the Atlantic Provinces. — *from* Author's abstract

Gloyna, Earnest F. *See* Kudo, Akira. 00657

08252 **Glynn, T. E.; Kirwan, R. W.; Wilson, N. E.** Measurements of the dynamic response of peat subjected to repeated loading [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 128-131, illus., 1970.

Peat samples were subjected to several thousand stress applications in undrained triaxial compression to simulate repeated loads from traffic. Four-inch diameter specimens of undisturbed fibrous peat were tested; specimens experienced simultaneous increases in axial stress and lateral stress duplicating the conditions of a soil element under transient load. During tests, displacements and pore-water pressures were recorded by transducers. The primary purpose of the research was to determine the "threshold stress" which can be placed on peat before major inelastic deformation occurs for application to roadway and vehicle track design. The threshold stress, which is the stress level where deformations change from elastic to inelastic, was examined. The resilient moduli, obtained by relating recoverable strains to applied stresses, was obtained for this peat. — Authors' abstract

Goettsch, Betty C. *See* Allen, William H., Jr. 00761

Goldberg, Edward D. *See* Weiss, Herbert V. 00924

Goldsmith, Richard. *See* Harwood, David S. 00649

Goodacre, A. K. *See* Stephens, L. E. 00703

08316 **Goodwin, Bruce K.; Johnson, Gerald H.** Geology of the upland gravels near Midlothian, Virginia, Pt. 2 *of* Atlantic Coastal Plain Geol. Assoc. Guidebook, 11th Ann. Field Conf., 1970: [Norfolk, Va.] Old Dominion Univ., 35 p., illus., 1970.

This part of the guidebook deals with a remnant of high-level gravels overlying bedrock of the Piedmont province. Circular to elliptical depressions occur on undissected tracts of gravel at 350 to 370 feet altitude; they are less than 15 feet deep, are bounded by a raised rim, and vary in diameter from a few hundred feet to three-quarters of a mile. Because of similarities between these and the Carolina Bays, the authors have adopted the same name for these shallow basins. Origin and nomenclature of the upland gravels are discussed and compared with those deposits on the coastal plain. The authors would prefer to place younger gravels at lower elevations with the Brandywine Formation. No attempt is made to correlate the Midlothian gravels, but they are considered to be fluvial. — ESL

00743 **Gorsline, D. S.; Brenninkmeyer, B. M.; Meyer, W. C.; Ploessel, M. R.; Shiller, G. I.; VonderHaar, S. P.** General characteristics of nearshore sediments from El Capitan to Ventura, California, 1969-70, Chap. 8 *in* Physical, chemical and geological studies, V. 2 *of* Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970: [Los Angeles, Calif.], Univ. Southern California, Allan Hancock Found., p. 296-317, illus., 1971.

Much of the variability between samples collected for this study and those from earlier investigations is due to sampling density, analytical methods, and component measured. If broad regional patterns are sought, the various studies all show similar trends: more sand in the west and more silt in the east; low carbonate; and high values on topographic highs. Organic contents show the influence of seeps in the Coal Oil Point area. Distribution of fine sediment is explained by two current eddies offshore, which in places oppose the pattern of sand drift to the east. The major flood is an im-

portant factor in these patterns, and fines are being reworked from the shelf. — *from* Authors' summary

Gorsline, D. S. *See* Felix, D. W. 00963

Gorsline, D. S. *See* Beer, R. M. 00964

00713 **Goudarzi, Gus H.** Geologic map of the Panther quadrangle, Daviess County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-866, scale 1:24,000, sections, text, 1971.

The map includes structure contours on the base of the Vienna Limestone. Mineral resources of the quadrangle are oil, coal, and gravel. — ESL

00716 **Goudarzi, Gus H.; Smith, Avery E.** Geologic map of part of the Owensboro West quadrangle, in Daviess County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-890, scale 1:24,000, sections, text, 1971.

Bedrock is of Mississippian-Pennsylvanian age. Structure contours on the base of the Vienna Limestone are included. Mineral resources are oil, gas, and coal. — ESL

08164 **Grant, A. C.; Manchester, K. S.** Geophysical investigations in the Ungava Bay-Hudson Strait region of northern Canada: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1062-1076, illus., 1970.

Continuous seismic profiler surveys have defined limits of the Paleozoic outlier in Ungava Bay, and indicated that similar rocks occur to the north beneath Hudson Strait, and have shown that strata underlying Hudson Strait are down-warped to form a synclinal structure with axis parallel to the Strait's bathymetric trend. Extrapolations suggest the southwestern side of Hudson Strait has been down-faulted relative to the block of Paleozoic strata in Ungava Bay. A seismic and magnetic profile from Frobisher Bay indicates a Paleozoic outlier occurs there as well. Although submarine physiography is primarily controlled by structure and secondarily modified by subaerial erosion, glacial erosion may account for local detail. — *from* Authors' abstract

Grant, J. A. *See* Austin, G. S. 08291

00605 **Grantz, Arthur.** The San Fernando, California, Earthquake of February 9, 1971 — Introduction, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 1-4, illus., 1971.

This earthquake points up the dangers to cities and the necessity for proper building design. The earthquake was of only moderate magnitude but resulted in 64 deaths and financial losses of at least one-half billion dollars. Uplift and warping of the surface above the rock wedge overlying the N-dipping thrust plane were prominent features of the earthquake and the cause of the great damage. Study of this earthquake and associated features can lead to identification and delineation of other active thrust faults in this region and elsewhere in the western United States. Most of the investigations reported in this publication are continuing, and more complete accounts will be published later. — VSN

00847 **Grasshoff, K. M.; Chan, K. M.** An automatic method for the determination of hydrogen sulphide in natural waters: Anal. Chim. Acta, v. 53, no. 2, p. 442-445, illus., table, 1971.

The methylene blue method is now applied as a standard procedure for determination of hydrogen sulfide in sea water. However, it is too sensitive to be applied without modification for the entire range of concentration, and a technique was developed which allowed dilution of the sample before formation of the methylene blue without any loss of the sulfide. This was done by immediate stabilization of the sulfide as zinc or cadmium sulfide which was kept in colloidal solution with gelatine. — ESL

00735 **Green, D. C.; Baadsgaard, H.** Temporal evolution and petrogenesis of an Archean crustal segment at Yellowknife, N.W.T., Canada: Jour. Petrology, v. 12, no. 1, p. 177-217, illus., tables, 1971.

Geochronology of Archean rock units in the Slave province reveals a tectonic cycle approximately 75 m.y. in duration. The oldest rocks (2650 m.y.) are basic metavolcanics with calc-alkaline characteristics. Metamorphic adjustment to green-schist facies conditions is largely isochemical. The basalt-dacite volcanic association is probably the early extrusive expression of subcrustal processes which led to intrusion of calc-alkaline batholiths into the deforming volcanic-sedimentary pile. Zircon U-Pb and whole rock Rb-Sr isochron ages of 2620-2640 m.y. are recorded for the synkinematic quartz-diorite batholiths and 2590-2610 m.y. for major late-kinematic bodies. Pegmatite adamellites (2575 ± 25 m.y.) are the youngest plutonic units. Comparison of results of the methods confirms that 100 m.y. may elapse between emplacement of a rock unit and closure of the biotite K-Ar system. — *from* Authors' abstract

Greene, H. Gary. *See* Clifton, H. Edward. 00622

00791 **Greensfelder, Roger.** Seismologic and crustal movement investigations of the San Fernando earthquake: California Geology, v. 24, nos. 4-5, p. 62-68, illus., 1971.

The epicenter of the San Fernando earthquake was about 10 km NNE of Sylmar, depth of focus is estimated as 12 km, and aftershocks covered an area from the main epicenter south to Sunland and southwest to Chatsworth. Preliminary focal mechanism solutions indicate oblique-slip reverse faulting on a plane dipping 50° to 60° N. and striking between N. 64° W. and due west; surface displacements (up to and exceeding 1 m) are a continuation of reverse faulting along the south flank of the San Gabriel Mts. The region has been one of low seismicity and points up the importance of identifying faults whose existence or seismic activity is unknown. The maximum horizontal acceleration of greater than that of gravity is the greatest ever recorded during an earthquake. Reobservations of 12 geodimeter lines crossing the San Andreas fault indicate a small relaxation in stress between Gorman and Cajon Pass. — VSN

00966 **Greer, Deon C.** Great Salt Lake, Utah: Assoc. Am. Geographers Annals, v. 61, no. 1, Map Supp. 14, scale 1:125,000, charts and text, 1971.

Precipitation, evaporation, and diversion are the principal factors affecting lake level. Most of the surface water entering the lake comes from the Wasatch Range to the east. The major collecting areas for ground water (supplying about one tenth of the annual input) is the Wasatch and the Oquirrh Mts. to the south; intensely faulted rocks in the Oquirrh provide for subsurface drainage. The annual difference in level averages 18 in., and has been declining since the 1870's. The chemical composition of the brine at four locations is shown by pie graphs. — ESL

00965 **Gresens, Randall L.; Stensrud, Howard L.** Chemical, optical, and X-ray analysis of an unusual muscovite-biotite intergrowth: Lithos, v. 4, no. 1, p. 63-69, illus., tables, 1971.

A specimen of intergrown biotite and muscovite from a [Georgia] pegmatite was subjected to detailed chemical, optical, and X-ray analysis. The crystals are intergrown in such a way that certain structural elements are common to both and that parts of the crystal structure must pass unbroken through the contact between them. Numerous edge dislocations must occur at the boundary because of the different basal spacings. Partitioning of elements between the minerals, along with the structural observations, suggest that the crystals are an equilibrium intergrowth. — Authors' abstract

08409 **Grice, R. H.** Quaternary geology of the Grand Rapids area, Manitoba: Canadian Jour. Earth Sci., v. 7, no. 3, p. 853-857, illus., table, 1970.

Grand Rapids is at the mouth of the Saskatchewan River on the western side of Lake Winnipeg in central Canada and is in the western part of the region formerly covered

by Glacial Lake Agassiz. Relict beaches and cliffs, and abandoned spillway and stream channels have been observed in the area. Much of the Paleozoic bedrock is covered by Quaternary deposits consisting of three or four Wisconsin tills interspersed and covered by glacio-lacustrine silts and clays. The events are correlated with the final four episodes in the general history of Lake Agassiz and it appears that after substantial changes in the drainage pattern, the recent course of the lower reaches of the Saskatchewan River developed during the last 8000 ± 250 yr. — Author's abstract

Griffin, W. L. *See* Murthy, V. Rama. 08267

Grimes, W. H. *See* Frey, M. G. 08408

Griswold, T. B. *See* Blackburn, W. H. 00771

00893 **Grommé, C. S.; Hay, R. L.** Geomagnetic polarity epochs—Age and duration of the Olduvai normal polarity event: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 179-185, illus., 1971.

New data show that the Olduvai normal geomagnetic polarity event is represented in Olduvai Gorge, Tanzania, by rocks covering a time span of roughly 0.1 to 0.2 m.y. and is no older than 2.0 m.y. Hence the long normal polarity event of this age that is seen in deep-sea sediment cores and in magnetic profiles over oceanic ridges should be called the Olduvai event. The lava from which the Gilsa event was defined may have been erupted during the Olduvai event and, if so, the term Gilsa should be abandoned. Many dated lavas that were originally assigned to the Olduvai event represent one or two much shorter normal polarity events that preceded the Olduvai event; these are herein named the Reunion normal polarity events. This revision brings the geomagnetic reversal time scale into conformity with one implied by assumptions of uniform sedimentation rates on the ocean floor and uniform rates of sea-floor spreading. — Authors' abstract

08229 **Gryc, George.** Geologic research in the Alaskan Arctic environment, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 48-50, illus. [1970].

The U.S. Geological Survey's program in Alaska is reviewed. From World War II on the Survey and the U.S. Navy have surveyed the petroleum potential of Alaska and described the geology of possible petroleum provinces. The Survey has continued basic geologic studies and investigations of metals and other mineral deposits as well as of geologic problems related to engineering which require mapping with emphasis on the distribution and physical characteristics of surficial materials, and especially of permafrost. Basic geologic mapping at the scale of 1:250,000 has been completed for 40 percent of the State and large-scale mapping covers about 1 percent. There is a need for rapid expansion of mapping for use in the development of the mineral industry and the administration of public lands. Remote-sensing and aeromagnetic surveys are important tools in achieving this goal although not substitutes for field observations. — EH

08403 **Guilcher, A.** Quaternary events on the continental shelves of the world [with French and German abs.], *in* The geology of the East Atlantic continental margin — ICSU/SCOR Working Party 31 Symposium, Cambridge, England, 1970, [Pt.] 1, General and Economic Papers: [Great Britain] Inst. Geol. Sci. Rept., no. 70-13, p. 31-46, illus., 1970.

Main Quaternary events on continental margins were the successive changes in sea level which produced subaerial features now drowned and which can be investigated by geophysical prospecting. A very large part, perhaps 70 percent, of the area of the shelves is till covered by relict sediments not yet concealed by younger deposits. Zonal types of Quaternary events may be defined; these can be recognized from a study of glacial or periglacial action in high and middle latitudes, and from interruptions in coral growth in a part of the intertropical belt. Lowerings of sea level and increased supply of sediments have affected sedimentation on the slope. Glacio-isos-

tasy and hydro-isostasy are also to be taken into account. The course of Holocene transgression is being investigated with much care, owing to its recent age. — *from* Author's abstract

00757 **Gunn, B. M.; Mooser, F.** Geochemistry of the volcanics of central Mexico: Bull. Volcanol., v. 34, no. 2, p. 577-616, illus., tables, 1971.

The Cenozoic volcanics of Mexico occur in two provinces, the Cordillera province made up of about 1,700 m of ignimbrite sheets overlain and intercalated in the upper part by olivine basalt and basaltic andesite, and the Rio Lerma Province consisting mainly of andesitic and dacitic lavas. A total of 108 chemical analyses were made for the major elements; 90 of these included determinations of Cr, Ni, Cu, Zn, Rb, Sr, Ba, Th, and Pb for two areas, the Valley of Mexico in the Rio Lerma Province and the Guadalajara region at the intersection of the two provinces. Geochemical considerations suggest that the andesite originated by partial melting of thoeliitic to pyrolitic material. The consistently higher $K:SiO_2$ and K:Rb ratios and lower $Mg:SiO_2$ ratio in the Guadalajara rocks suggests that they were generated at greater depth than the Valley of Mexico rocks. — DBV

08223 **Gurke, John L.** Shipboard data acquisition — Why use a computer,, Chap. 7 *in* UnderSea Technology Handbook Directory 1970: Arlington, Va., Compass Publications, p. A63-A68, illus., 1970.

Whether or not a computer should be used on shipboard for data acquisition can be decided only after designing the survey and determining the optimum approach. Most marine surveys can be designed around the following elements: end use of data, instruments, data observer, platform, survey procedures, data display, logistics, and schedule. The bearing of each of these elements upon the computer decision is examined. — VSN

Hackman, Robert J. *See* Williams, Paul L. 00680

08133 **Hacquebard, P. A.; Donaldson, J. R.** Coal metamorphism and hydrocarbon potential in the Upper Paleozoic of the Atlantic Provinces, Canada: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1139-1163, illus., tables, 1970.

Coal rank is used to measure the degree of organic metamorphism. Vitrinite reflectance on true coal seams is used, and an isoreflectance map is constructed which shows a distinct pattern of regional metamorphism that resembles the tectonic development of the region. Coalification is predominantly postdeformational, and high-rank coals show increase of reflectance with burial. In these coals, different R_o-depth factors were obtained in different areas which can be related to different geothermal gradients. In the lower rank coals, the reflectance parameter is useful only on a broad scale, and precise rank predictions at depth cannot be made from surface observations. From borehole reflectance samples, however, an approximate vertical position of the oil "deadline," with regards to the degree of organic metamorphism can be determined. Factors limiting the selection of promising areas for future exploration are discussed. — HRC

00916 **Haefner, Richard.** A note on "lancasterite" from Cedar Hill and Texas, Pennsylvania: Mineralog. Record, v. 2, no. 1, p. 39-40, 1971.

Discovery of an article on "the new American mineral, lancasterite," in an 1850 issue of American Journal of Science, led to further investigations. The name "lancasterite" was proposed by Benjamin Silliman, Jr., for a mineral foliated like brucite, and also in small crystals. A chemical analysis differed from any other published analyses, but was not always consistent. Three years after the discovery, Smith and Brush decided to separate the two types of "lancasterite" and analyze them separately. The foliated type had the same composition as brucite, and the small crystals, the same as hydromagnesite; so "lancasterite" is not a distinct species, but a mechanical mixture of two. Silliman failed to recognize the two minerals because they were quite intimately mixed, and no one had ever before found hydromagnesite crystals. — ESL

Hall, I. H. S. *See* Bateson, J. H. 00854

00691 **Hall, John W.; Swain, Albert M.** Pedunculate bracts of *Tilia* from the Tertiary of western United States: Torrey Bot. Club Bull., v. 98, no. 2, p. 95-100, illus., 1971.

Pedunculate bracts of *Tilia* (linden) are those in which the pedicel is attached at the base, and not connate to the bract surface. Two modern eastern Asian species have this presumably primitive type of bract. Fossil species with pedunculate bracts have been found in Europe and eastern Asia and at two other localities of similar latitude in western U.S. The present material is from the Geertson Formation, Lemhi County, Idaho, Oligocene or Miocene in age, and is referred to *T. parvifolia* H. V. Smith. The abundant bracts, flowers, fruits, leaves, and pollen are described. Phytogeographic dispersal of *Tilia* is discussed, particularly the relationship between eastern Asiatic and western North American species. — *from* Authors' abstract

08397 **Hall, Warren A.; Dracup, John A.** Water resources systems engineering: New York and San Francisco, McGraw-Hill Book Company, 372 p., illus., tables, 1970.

This textbook is designed to present certain fundamentals of the systems approach to complex water resources problems. Specific systems and subsystems have been selected as examples of important facets of the systems approach and for their value as analytical methods for particular problems. The text has nine chapters: introduction; nature of water resources systems; systems analysis; objective functions of water resources development; applications of systems analysis to water resources systems elements; water resources investment timing; large-scale, complex, multiple-purpose water resources systems; analysis of ground-water systems; and water quality subsystems. — VSN

00826 **Hallam, A.** Mesozoic geology and the opening of the North Atlantic: Jour. Geology, v. 79, no. 2, p. 129-157, illus., 1971.

Mesozoic-Cenozoic igneous and tectonic activity, and types and distributions of epicontinental sediments and fossils are evaluated to interpret the historical sequence of separation of continents to form the North Atlantic. The initial fit of the continents along the Quiet Magnetic Zones is preferred over the fit at the 500-fathom contour. Evidence suggests that the southern North Atlantic began opening first, in the Jurassic, but was preceded by late Triassic tension-subsidence and volcanism. Rifting extended progressively northward during the Cretaceous, with an accelerated rate of sea-floor spreading in latest Cretaceous. The northern North Atlantic commenced opening in early Cenozoic. A northward movement of Africa Toward Europe occurred in late Cenozoic, with continental spreading continuing to the present. — VES

00921 **Halliday, Ian; Blackwell, A. T.** The search for a large meteorite near Prince George, British Columbia: Meteoritics, v. 6, no. 1, p. 39-47, illus., 1971.

A meteoritic event was observed from the vicinity of Prince George, British Columbia, at 5^{h} 58^{m} U.T., August 21, 1969, and an associated ground impact wave was recorded by several seismograph stations. An analysis of the visual and seismic data indicates that a mass of several tons must have reached the ground about 20 km southeast of Prince George. A helicopter search of the area and a study of aerial photographs have failed to locate the impact site. — Authors' abstract

Halliday, W. *See* Scrimger, J. A. 00786

Hanks, T. C. *See* Allen, C. R. 00608

00644 **Hanks, Thomas C.; Jordan, Thomas H.; Minster, J. Bernard.** Precise locations of aftershocks of the San Fernando earthquake 2300 (GMT) February 10-1700 February 11, 1971, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 21-23, illus., table, 1971.

Analysis of the 47 aftershocks to the San Fernando earthquake occurring in the above period indicates three groups of events which can be identified on the basis of hypocentral characteristics and type of focal-mechanism solution. Deepest hypocenters of the epicentral group define a thrust plane dipping north 32°, striking about E-

W, and intersecting the surface in the Sylmar and Tujunga fault segments. The main shock hypocenter falls below the plane, but its depth determination is reliable to only ± 4 km. Events in the Chatsworth segment, extending southwest from the main shock, define a linear seismic zone, hypocenters are below the thrust plane, and depth determinations are relatively uniform; fault-plane solutions for this group are consistent with left-lateral strike-slip. Hypocenters of the shallow eastern group fall above the thrust plane and are difficult to relate to the epicentral group. — VSN

Hanks, Thomas C. *See* Wyss, Max. 00663

08253 **Hanrahan, E. T.; Quinn, W. J.** A fundamental analysis of the strains in stressed specimens of peat [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 132-135, illus., 1970.

In common laboratory triaxial or one-dimensional test apparatus there is likely to be incomplete definition of either stress or strain. A new formula is presented relating stress with strain, and laboratory test results are presented which confirm its validity. A modified triaxial test is described which provides plane strain consolidation with full definition of stress. The boundary σ_1/σ_3 ratio was found to vary widely which introduces an important new mechanism into the consolidation process. — Authors' abstract

08198 **Hansen, Hans Jorgen.** Danian foraminifera from Nügssuaq, West Greenland — With special reference to species occurring in Denmark [with Danish summ.]: Medd. Grönland, v. 193, no. 2, 132 p., illus., 1970; *reprinted as* Grönlands Geol. Undersögelse Bull. 93, 1970.

Stratigraphy of the lower Paleocene (Danian) Kangilia and Agatdal Formations exposed at 11 localities in Nügssuaq is discussed. Biostratigraphic zonation of Danian deposits in Denmark and throughout the world is based on planktonic foraminifera. Lower Danian age of the Kangilia is based on a rich macrofauna, as the only foraminifer identifiable so far is the fischerinid *Cornuspirioides primigenia*, described by Ravn (1918) as a gastropod. Upper Danian age of the Agatdal is based on planktonic foraminifera, including *Globoconusa daubjergensis*, *Subbotina triloculinoides*, *S. pseudobulloides*; 57 foraminiferal species (8 new) in 44 genera (including *Paralabamina*, n.gen., from Eponides) are described from the Sonja Member. *Bulimina* species are discriminated by proloculus diameter. *Subbotina* is distinguished from *Globigerina* by wall ultrastructure. — VMJ

08405 **Hansen, Kaj.** Geological and geographical investigations in Kong [!] Frederik IX's Land — Morphology, sediments, periglacial processes and salt lakes: Medd. Grönland, v. 188, no. 4, 77 p., illus., tables, 1970.

Söndre Strömfjord and its continuation, Sandflugtdalen, constitute a morphologic border between two landscapes. Towards the north the trend of valleys and ridges is ENE-WSW parallel with folding axes and diaclases of the Precambrian; towards the south, ice erosion has influenced the relief much more and main trends are SE-NW. Sediments in Sandflugtdalen are homogeneous silt deposits; mean grain size is about 30 μ, sorting is very good, and content of sand and clay is very low. There are several salt lakes and also hillocks, solifluction terraces, and other periglacial features. Salt lakes are peculiar in that the ion content differs strongly from that of other salt lakes; sulfate ions are almost lacking because of low summer temperatures and low evaporation, and the moisture from slowly thawing permafrost. Sulfate ions in water seeping through soil are reduced to sulfide and precipitated in soil with iron. — *from* Author's abstract

Harakal, J. E. *See* White, William H. 08135

Harbaugh, John W. *See* Bonham-Carter, Graeme. 00748

08242 **Hardy, R. M.** Design, construction and performance of dykes founded on peat [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 39-44, illus., 1970.

The application of earlier research on the engineering properties of peat to the construction of dikes on peat foundations is dealt with. Some 11 miles (18 km) of dike varying in height to a maximum of 30 ft (9 m) were founded on peat varying in thickness to a maximum of 10 ft (3 m). The basic theoretical concepts are outlined, and the site investigations and results from two test sections to confirm these are presented. The methods used in arriving at the final design are discussed. Winter construction procedures, used for some of the work, are described. Performance records of the dikes are given. Relatively low rates of secondary consolidation developed, and the reasons for this are advanced. — Author's abstract

08147 **Harington, C. R.** A Pleistocene muskox (*Ovibos moschatus*) from gravels of Illinoian age near Nome, Alaska: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1326-1331, illus., table, 1970.

A muskox cranial fragment from outwash gravels of Illinoian age near Nome, Alaska is referable to *Ovibos moschatus*, which survives in arctic Canada and Greenland. The specimen is evidence suggesting that *O. moschatus* first entered North America from Eurasia across a land connection during the penultimate (Illinoian) glaciation. — Author's abstract

Harington, C. R. *See* Crossman, E. J. 08194

Harris, D. C. *See* Schwarz, E. J. 08205

08204 **Harris, Stuart A.** The Waterloo kame-moraine, Ontario, and its relationship to the Wisconsin advances of the Erie and Simcoe ice lobes [with German and French summaries]: Zeitschr. Geomorphologie, v. 14, no. 4, p. 487-509, illus., table, 1970.

This hummocky ridge of water-laid sands veneered with till deposits, trends NNW-SSE, at about right angles to alignments of other moraines in the area. Road cuts show that sands in its core are older than earliest Wisconsin tills of the Erie lobe. Absence of buried soils suggests it was deposited immediately prior to the Erie lobe ice advance, which produced the Canning till. The shape of the structure, kettle holes, horizontal bedding, and increase in degree of sorting to the west suggest stagnation of a Simcoe lobe ice sheet. The kame-moraine is overlain by six thin tills, four of them from Erie lobe ice and two from Simcoe lobe sheets. The first two ice sheets, corresponding to Canning and Flamborough tills, apparently covered the entire kame-moraine; the later, post-Port Talbot sheets left refugia some 300 km north of what has been regarded as the southern margin of the late Wisconsin ice cap; only in early Wisconsin times did two different lobes meet in this area. — *from* Author's summary

00974 **Harrison, W.** Atlantis undiscovered — Bimini, Bahamas: Nature, v. 230, no. 5292, p. 287-289, illus., 1971.

Underwater remains of an originally coherent formation of coquina limestone have been misinterpreted as prehistoric stonework. Marble and cement cylinders are found nearby. The cement cylinders are all of the same size and shape (barrel-shaped); most likely they were cast in barrels now broken up or lost. Those who believe that the cylinders are fragments of Olmec or Atlantean pillars should consider a more mundane explanation of the marble and cement cylinders — namely, construction materials that were being transported by ship which came to rest on the sea floor at this point by accident or by design. — Author's abstract

Harriss, Robert C. *See* Williams, Harold H. 08115

08300 **Harshbarger, John W.** Water resources in the Tucson basin, Section 5 *in* Mining and ecology in the arid environment — Conf., Tucson, Ariz., 1970, Proc. (W. C. Peters, editor): Tucson, Arizona, University of Arizona, College of Mines, Sec. 5-1 to 5-2 [1970].

The author summarizes the water resources of the Tucson basin in the Santa Cruz valley in Arizona. The main resource for irrigation, public supply, and industrial use is ground water pumped from the alluvial aquifer underlying the basin. Almost no

surface water is diverted from streams. Recharge to the ground-water reservoir is from streamflow infiltration along the Santa Cruz channel and its tributaries, runoff from the mountains, and return flow from surplus irrigation water and sewage effluent. The major hydrologic components of the upper Santa Cruz basin comprise one of the most efficient natural water systems in the southwestern United States. Stream characteristics, and water uses and losses are described. — EH

08301 **Harshbarger, John W.** Groundwater systems in the San Pedro Valley, Mammoth area, Section 6 *in* Mining and ecology in the arid environment — Conf., Tucson, Ariz., 1970, Proc. (W. C. Peters, editor): Tucson, Arizona, University of Arizona, College of Mines, Sec. 6-1 to 6-2 [1970].

Ground water in the San Pedro River valley in southeastern Arizona is obtained from the Quiburis formation, a sequence of alluvial deposits 1,000-1,500 feet thick, and Pleistocene and recent alluvial deposits in quantities and quality sufficient to satisfy present domestic and irrigation demands in the central part of the valley. The shallow aquifer ranges in thickness from 60-150 feet and averages 3/4 mi in width in the Mammoth area and is recharged by intermittent streamflow. Legal aspects of the water supply are discussed. The geology of the Quiburis formation, which contains two artesian systems in the Mammoth area, is described. Temperature ranges of 87°-109°F are found in some wells and chemical quality ranges from 200 to more than 600 ppm dissolved solids. — EH

08336 **Harshbarger, John W.** Source, movement and development of water in arid regions, *in* Mining and ecology in the arid environment — Conf., Tucson, Ariz., 1970, Proc. (W. C. Peters, editor): Tucson, Arizona, University of Arizona, College of Mines, p. 122-134, illus. [1970].

Several salient aspects of water resources in arid regions and related physical processes are presented to give an overview of the magnitude of water resources potential and complexities of development. Characteristics of hydrologic components are briefly described as well as ground-water development in alluvial basins. The Colorado Plateaus and the Egyptian Sahara are used as examples in discussing sandstone aquifers. The hydrogeology of carbonate rocks in Jordan and of the Capillune sequence of clastic sedimentary rocks, volcanics and pyroclastics in Peru are described. — EH

08161 **Harshman, E. N.** Uranium ore rolls in the United States, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 219-232, incl. discussion, illus., 1970.

About 40 percent of the uranium reserves in the United States are in roll-type deposits in Wyoming. Host rocks are arkosic sandstones, deposited in intermontane basins under fluvial conditions, and derived from granitic cores of flanking mountains. Host rocks are Eocene, possibly Paleocene, and are, or were, overlain by a sequence of continental tuffaceous siltstones, sandstones, and conglomerates 400-700 m thick. Most ore is unoxidized and lies below the water table. Uranium-bearing minerals are uraninite and coffinite, and the ore averages 0.25 percent U_3O_8. Orebodies are genetically related to large tongues of altered sandstone. The character of alteration and distribution of elements suggests that ground water was the ore-bearing fluid. Similar deposits have been discovered in the Gulf Coastal Plain of Texas. — *from* Author's abstracts

08270 **Hart, S. R.; Brooks, C.; Krogh, T. E.; Davis, G. L.; Nava, D.** Ancient and modern volcanic rocks — A trace element model: Earth and Planetary Sci. Letters, v. 10, no. 1, p. 17-28, illus., tables, 1970.

Our model for modern oceanic and island-arc basalts suggests derivation of alkali basalts from non-depleted mantle by low degrees of partial melting at relatively great depths; low-K tholeiites are explained as products of high degrees of partial melting of residual or depleted mantle at relatively shallow depths. Basalts of the Archean (2.7 b.y.) greenstone belts of Canada average 2100 ppm K, 6 ppm Rb, 0.4 ppm Cs, 175 ppm Sr, and 70 ppm Ba. These trace-element abundances show that the Archean

basalts are closely related to the low-K tholeiites of island arcs. It is proposed that the Archean basalts are derived by high degrees of melting at shallow depths. No evidence of residual or depleted mantle during the Archean is found. Our model implies a thin lithosphere during the Archean and the volcanics evolved in an environment dominated by multiple thin oceanic plates with arc-trench boundaries and shallow subduction zones. — *from* Authors' abstract

00649 **Harwood, David S.; Goldsmith, Richard.** Surficial geologic map of the Oneco quadrangle, Connecticut-Rhode Island: U.S. Geol. Survey Geol. Quad. Map GQ-917, scale 1:24,000, sections, text, 1971.

All glacial deposits are believed to be of Wisconsinan age, and consist of till and stratified drift. The glacier advanced to the southeast in this area. Deglaciation began with thinning of the ice and forming of melt-water streams; large blocks of dead ice were left behind, and glacial lakes formed in lowlands. Sand and gravel are the most valuable surficial resources. Stratified deposits are the largest source of ground water. — ESL

Haug, P. *See* Simoneit, B. R. 00905

Hawley, C. C. *See* MacKevett, E. M., Jr. 00685

Hay, R. L. *See* Gromme, C. S. 00893

00687 **Hazel, Joseph E.** Ostracode biostratigraphy of the Yorktown Formation (upper Miocene and lower Pliocene) of Virginia and North Carolina: U.S. Geol. Survey Prof. Paper 704, 13 p., illus., table, 1971.

The Yorktown Formation of Virginia and North Carolina is divided into three ostracode assemblage zones. The first two are late Miocene in age and the last is considered to be early Pliocene. Rapid transgression of the sea occurred during early Yorktown time to a maximum during middle Yorktown time. A more or less steady regression of the sea to the southeast followed during the remainder of Yorktown time. — JEH

Healey, D. L. *See* Carr, W. J. 00879

00705 **Healy, Henry G.** Water levels in artesian and nonartesian aquifers of Florida, 1967-68: Florida Bur. Geology Inf. Circ., no. 68, 61 p., illus., table, 1971.

The trends and fluctuations of ground-water levels in the principal aquifers in Florida during 1967-68 are summarized, including: hydrographs of ground-water levels in several aquifers; maps showing changes in ground-water levels during specific periods; and a table summarizing principal data on selected observation wells. Principal aquifers for agricultural, industrial, and municipal uses in Florida are the Floridan Aquifer in central and northern, the Biscayne Aquifer in southeastern, and the sand-and-gravel aquifer in the extreme northwestern part of the state. Groundwater levels are discussed for specific areas of high population and industrial growth in northwestern, northern and north-central, central, and southern Florida. — VSN

00794 **Hedberg, Leonard L.; Parry, William T.** Clay mineralogy at the brine-sediment interface in the south arm of Great Salt Lake, Utah: Utah Geol. and Mineralog. Survey Spec. Studies 35, 12 p., illus., tables, 1971.

The clay mineralogy of 23 cores collected in the south arm of Great Salt Lake was determined using X-ray diffraction. Mean composition of clays from the lake is 51 percent K-mica, 39 percent montmorillonite and interstratified illite-montmorillonite, and 10 percent kaolinite. Great Salt Lake clays are not in chemical equilibrium with lake brine. K-mica is a stable mineral in the lake brine and should form at the expense of kaolinite and montmorillonite. Pore brines from the clays contain less sodium, potassium and magnesium than lake brine. These ions may be reacting with clay minerals through cation exchange in the process of diagenesis. — Authors' abstract

Hedge, Carl E. *See* Noble, Donald C. 08274

00982 **Hekinian, Roger.** Petrological and geochemical study of spilites and associated rocks from St. John, U.S. Virgin Islands: Geol. Soc. America Bull., v. 82, no. 3, p. 659-681, illus., tables, 1971.

These rocks are taken from a continuous core representing the upper 1180 feet of a 2430 ft drill core and containing a cumulative 950 feet of altered mafic extrusive rocks (spilite). The investigation includes petrographic and X-ray diffraction studies, and 132 partial chemical analyses, all for nine components. Prehnite and pumpellyite disappear below 700 feet in the core with concomitant increase in actinolite, suggesting burial metamorphism grading downward into the greenschist facies. — AG

08314 **Helenelund, K. V.** Compression, tension and beam tests on fibrous peat [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 136-142, illus., tables, 1970.

The influence of fibers on strength and stress-strain properties of *Sphagnum* peat was studied in horizontal and vertical compression and tension tests and in horizontal beam tests. The ratio of horizontal to vertical unconfined compressive strength varied from 0.44 to 1.58 with a mean value of 0.90. In vertical compression tests no failure plane was observed, but in horizontal compression tests the point of failure was clearer. The ratio between horizontal and vertical tensile strength varied between 1.5 and 9.8 with a mean of 4.32. The ratio between mean tensile strength and unconfined compressive strength varied in different layers in the vertical direction between 0.11 and 0.40, the mean value being 0.27. The ratio between horizontal tensile strength and horizontal unconfined compressive strength increased with depth from 0.44 at 0.25 m depth to 2.30 at 1.50 m depth. Mean elastic flexural strength was 1.64 times horizontal tensile strength. — *from* Author's abstract

08335 **Helfer, Jacques R.** How to know the rocks and minerals: Dubuque, Iowa, Wm. C. Brown Company Publishers, 228 p., illus., 1970.

The primary emphasis of this elementary textbook is on presentation of keys for the identification of numerous minerals and the major rock types. Introductory material gives a brief review of some of the basic characteristics of rocks and minerals. — VSN

08344 **Henderson, William A., Jr.** Rutile from Watertown, Connecticut: Mineralog. Rec., v. 1, no. 3, p. 88-90, illus., table, 1970.

In a single piece of schist collected from a roadcut in Watertown, a cavity nearly filled with iron oxides, when cleaned, showed among other crystals about a dozen brilliant ruby-red crystals taken to be highly distorted garnets. Faces on the best one, assigned to the hexoctahedral class of the isometric system, are illustrated. Angles, measured by a previously described one-circle goniometer (ibid., no. 2, 1970), are listed in the table with known values for garnet, rutile, anatase, and cassiterite, chiefly from Dana's Textbook of Mineralogy. The angles found did not match those of garnet, but agreed with those for rutile to within less than one degree, as did the minor ditetragonal dipyramid. Other minor faces were too small to give good measurements with this goniometer. Angles found that are not listed in Dana may represent a new form, but a more precise goniometer is required to establish it. — GDC

Hendricks, Ernest L. *See* Cywin, Allen. 08389

Henniger, B. R. *See* Overbey, W. K., Jr. 00910

08390 **Herr, Lester A.** The control of erosion and sediment in highway construction, *in* National Conference on Sediment Control, Washington, D.C., 1969, Proc: Washington, D.C., U.S. Dept. Housing and Urban Development Environmental Planning Division, p. 41-47, 1970.

Fifty years ago, highway engineers accepted erosion and sediment as a fact of life; early roads just happened with maintenance limited to annual spring shape-up. Progressive engineers have recognized the importance of designing, constructing and maintaining highways so they fit into landscape, avoid unsightly scars and preserve wildlife habitat. Points in design and construction to minimize erosion are briefly outlined for various problems, climatic areas, and soil conditions. — GDC

00774 **Hesselbjerg, Erik.** Muligheder i Grönlands undergrund? (Are there possibilities in Greenland's subsoil,): Grönland, no. 3, p. 65-76, illus., 1971.

This article discusses mineral resources of Greenland, the lead mines at Mesters Vig, cryolite at Ivigtut, and iron ore between Godthab and Sukkertoppen, and the economics of their exploitation. — EH

Hey, M. H. *See* Donnay, Gabrielle. 00952

Hey, Max H. *See* Leavens, Peter B. 08346

00954 **Heyl, A. V.** Some aspects of genesis of zinc-lead-barite-fluorite deposits in the Mississippi Valley, U.S.A. [Reply to discussion by A. C. Dunham and others of 1969 paper]: Inst. Mining and Metallurgy Trans., Sec. B. v. 80, Bull. 771, p. B70-B71, 1971.

Original paper was published, ibid., v. 78, Bull. 756, p. B148-B160, 1969 (Abs. North American Geology, December 1970); for discussion by A. C. Dunham and others, *see* ibid., v. 79, Bull. 762, p. B91-B96, 1970. — GDC

00976 **Hibbard, Claude W.; Bjork, Philip R.** The insectivores of the Hagerman local fauna, Upper Pliocene of Idaho: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 9, p. 171-180, illus., tables, 1971.

The insectivores of the Hagerman local fauna (Glenns Ferry Formation) include the shrews *Blarina gidleyi* Gazin, 1933 (the most abundant shrew in the fauna) and four species of *Sorex*; a mole, *Scapanus* sp.; and a shrew-like mole, Talpidae gen. and sp. indet. Three species of *Sorex* are new: *S. hagermaniensis, S. powersi, S. meltoni; Sorex* cf. *S. rexroadensis* is also present. On the basis of comparative measurements of upper dentition, *B. gidleyi* is removed from *Blarina* and assigned to *Paracryptotis* Hibbard, 1950, of which the diagnosis is emended. — *from* Authors' abstract

08393 **Hidalgo, Robert V.; Renton, John J.** The use of pelletized samples for X-ray diffraction analysis of clay minerals in shale: West Virginia Geol. and Econ. Survey Circ. 12, 9 p., illus., 1970.

The advantages of pelletizing as a sample preparation technique for X-ray diffraction analysis of clay minerals in shale include freedom from errors inherent in sedimentation (slide-mounted) samples, reproducibility of results, excellent limits of detection, simplicity and speed of preparation, and freedom from sample preparation variables such as particle size, sample composition, and pelletizing pressures. — *from* Authors' abstract

Higgins, Jon L. *See* Boyer, Robert E. 08281

00884 **Higgins, Michael W.; Fisher, George W.** A further revision of stratigraphic nomenclature of the Wissahickon Formation in Maryland: Geol. Soc. America Bull., v. 82, no. 3, p. 769-774, illus., tables, 1971.

The Wissahickon Formation, the thickest and most extensive unit of the Glenarm Series, was divided into lithofacies several years ago. We suggest revision of two of these lithofacies and addition of another. We also suggest that the term lithofacies be shortened to facies. The added facies, the quartzite facies, is distinguished by metamorphosed orthoquartzites and protoquartzites. It corresponds in part to the former Peters Creek quartzite. — Authors' abstract

Hileman, James A. *See* Lahr, John C. 00616

00877 **Hoffer, Jerry M.** Mineralogy and petrology of the Santo Tomas-Black Mountain basalt field, Potrillo Volcanics, south-central New Mexico: Geol. Soc. America Bull., v. 82, no. 3, p. 603-611, illus., table, 1971.

The Santo Tomas-Black Mountain basalts were erupted during the Quaternary from four centers. Six lava flows are at Black Mountain, three at Santo Tomas, and one each at Little Black Mountain and San Miguel. The basalts are grouped into three major types of phenocryst mineralogy: plagioclase abundant; olivine abundant; and olivine and plagioclase abundant. All three types are alkali-olivine basalts, showing high alkali-silica ratios and total alkali content increasing with silica. Seven periods of basaltic extrusion among the centers have been established on the basis of field evidence, phenocryst mineralogy, and pyroxene-olivine ratios. K-Ar dates show the basalts to be less than 0.3×10^6 m.y. old. The basalts are thought to have originated from a single small, shallow magma chamber which was under the influence of a high thermal gradient during differentiation. — *from* Author's abstract

Hoffer, Jerry M. *See* Strain, William S. 00919

Holden, John C. *See* Dietz, Robert S. 00890

Hole, Francis D. *See* Milfred, Clarence J. 08264

08146 **Holman, J. Alan.** Herpetofauna of the Wood Mountain Formation (Upper Miocene) of Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1317-1325, illus., 1970.

An upper Miocene deposit, the Kleinfelder Farm locality of the Wood Mountain Formation near Rockglen, Saskatchewan, yielded two anurans, an unidentified crocodilian, two lizards, and five snakes. All identifiable forms, with exception of two colubrid snakes, represent living genera; some are close to modern subgenera or to modern species. A species of glass lizard (*Ophisaurus*) and a genus of racer-like colubrid snake are new. The glass lizard may be ancestral to the two modern species, *O. ventralis* and *O. attenuatus*, but affinities of the colubrid are not well understood. Climate of the region must have been much warmer than today; east and west rainfall zonation on the continent may have been less pronounced. The Kleinfelder Farm locality herpetofauna shows similarities to the Norden Bridge Quarry herpetofauna of the Valentine Formation of Brown County, Neb., but the Kleinfelder site may be somewhat older. — *from* Author's abstract

08351 **Holman, J. Alan.** Possible habits of juvenile prototetrapods: Michigan Academician, v. 3, no. 2, p. 101-103, 1970.

A sequence of habits is suggested that might have evolved in juvenile prototetrapods relative to aquatic predator pressure. If young prototetrapods spent time in shallow water looking for food, the logical escape mechanism from predatory fishes would have been to rush away, some possibly resulting in escape by land. Since prototetrapods had well-developed lungs, the return to water would not have been critical, and limbs as well as the habit of escaping to land might have been rapidly selected. The escape to land may have evolved into a pattern of spending part of the time sheltering on land under various objects with introduction to a new source of food in some small land invertebrates, and leading to similar to salamanders. As adult animals the prototetrapods could return to water as large aquatic predators. — VSN

Homan, Paul T. *See* Schurr, Sam H. 00951

00695 **Hopkins, D. M.; Matthews, J. V.; Wolfe, J. A.; Silberman, M. L.** A Pliocene flora and insect fauna from the Bering Strait region: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 9, no. 3, p. 211-231, illus., tables, 1971.

A flood-plain forest [mainly spruce-birch, with diversified assemblage of other types] has been preserved beneath a lava flow that invaded the Inmachuk River Valley in northern Seward Peninsula, Alaska, during Pliocene. The flora is of great biogeographic interest because of its position in a tundra region about 250 km east of Bering Strait, 75 km south of the Arctic Circle, and 65 km west of the northwestern limit of

spruce-birch forest. It provides insight into the history of development of the circumpolar boreal forest (taiga). A rich arthropod fauna casts light on the phylogeny of several modern insect genera and on origin of modern tundra faunas. K-Ar analysis of the overlying basaltic lava provides the first radiometric age (5.7 ± 0.2 m.y.) for the Clamgulchian Stage, a late Tertiary time-stratigraphic unit based on fossil plants and widely recognized in Alaska and northeastern Siberia. — *from* Authors' abstract

Hopkins, W. S., Jr. *See* Waldman, M. 08195

00736 **Horton, J. W.; Brown, R. C.; Davidson, D. W.; Dickas, A. B.; Lunking, W.; Roubal, R. K.** Sedimentological and chemical parameters of the Lake Superior neritic zone, south shore: Wisconsin Acad. Sci., Arts and Letters Trans., v. 59, p. 67-77, illus., tables, 1971.

A pilot study of water quality of the neritic zone of an area on the western end of the south shore of Lake Superior produced the following conclusions: A standard distribution of Lake Superior clastics occurs within the study area, with a few anomalous zones caused by lake-floor surface pockets of clay, initially deposited as lacustrine sediments during the Wisconsin sub-epoch in Lake Duluth. Specific conductance decreases slightly from shoreline outward and from surface to bottom and approximately equals that of a 7×10^{-4} MKCL solution. pH unit values are quite uniform, with highest and lowest values at the shoreline possibly indicative of leaching. Dissolved oxygen values are nearly constant, averaging 10.5 - 10.8 ppm, with highest values at the shoreline. Average total dissolved solids value are 71.5 ppm. — EH

00674 **Hörz, Friedrich; Ronca, Luciano B.** A classification of impact craters: Modern Geology, v. 2, no. 2, p. 65-69, illus., 1971.

A systematic classification of meteorite impact craters based on $\log_{10}$ crater diameter (km) is proposed. The following classes were differentiated: 2μm-200μm diameter-nanocraters; 200μm-2cm diameter-microcraters; 2cm-2m diameter-craterlets; 2m-200m diameter-small craters; 200m-20km diameter-intermediate craters; 20km-2000km diameter-large craters. Such a classification is believed to facilitate the discussion of lunar craters and impact structures on other planetary surfaces. — Authors' abstract

Hosman, R. L. *See* Calandro, A. J. 08185

00934 **Hotz, Preston E.** Geology of lode gold districts in the Klamath Mountains, California and Oregon: U.S. Geol. Survey Bull. 1290, 91 p., illus., tables, geol. map, 1971.

The Klamath Mountains geologic province has four N-trending, arcuate, lithologic belts, from E-W: eastern Klamath belt — 40,000-50,000 feet of Ordovician (?) to Jurassic eugeosynclinal clastic sediments and volcanics; central metamorphic belt — Salmon Hornblende Schist and Abrams Mica Schist with initial Rb-Sr metamorphic age in Devonian; western Paleozoic and Triassic belt — eugeosynclinal assemblage of Permian to Triassic of clastics, chert, mafic volcanics, and marble metamorphosed to lower greenschist facies; and western Jurassic belt — slate and graywacke of the Galice Formation and volcanic rocks. Thrust faults bound the belts, each of which has overridden its western neighbor. Ultramafic bodies and granitic plutons occur in all belts; isotope ages define episodes of granitic intrusion at 165-167, 145-155, and 127-140 m.y. Cretaceous marine sediments overlap older formations on north, northeast, and southeast. The history of mining, and occurrence of gold are discussed in detail. — VSN

00849 **Howard, James C.** Computer simulation of salt domes: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 495-513, illus., tables, 1971.

Salt dome forms are simulated by (1) viscous flow models which predict overall forms during early growth, (2) coupled viscous flow and random walk models which simulate spines on non-piercement domes, (3) random walk models which simulate development of spires, ledges, and overhangs on piercement salt domes. The random

walk model predicts changes in dome forms for various rates of (a) subsidence of salt basin, (b) sedimentation, (c) compaction of overburden, and for differential movements of salt dome segments. A test of the method involves simulation of the Belle Isle salt dome, Louisiana. — EGS

00928 **Hrabar, S. V.; Cressman, E. R.; Potter, Paul Edwin.** Crossbedding of the Tanglewood Limestone Member of the Lexington Limestone (Ordovician) of the Blue Grass region of Kentucky: Brigham Young Univ. Geology Studies, v. 18, pt. 1, p. 99-114, illus., tables, 1971.

Crossbedding measurements (541) were obtained from this member in 16 7-1/2-minute quadrangles in the Blue Grass region. Crossbedding orientation in individual outcrops as well as by quadrangles commonly is bimodal with the two modes 180° apart. Modes tend to be perpendicular to isopachs which define a NNW-trending body of echinodermal-bryozoan calcarenite, interpreted as having formed a bank that stood higher than the surrounding areas. Tidal currents, moving perpendicular to bank topography, produced sand waves that migrated to and fro. Regionally, the bank was part of a much larger carbonate shelf that extended from southern Ohio into Tennessee. Incomplete data suggest that paleocurrents on this shelf produced pararipples oriented parallel to the depositional strike of the shelf, with a net seaward transport toward a deeper water basin to the northwest in which terrigenous mud accumulated. — *from* Authors' abstract

00989 **Hsu, Shih-Ang.** Measurements of shear stress and roughness length on a beach: Jour. Geophys. Research, v. 76, no. 12, p. 2880-2885, illus., table, 1971.

Measurements of surface shearing stress and aerodynamic roughness length on a beach were made by simultaneous temperature- and wind-profile methods in the following three areas of the beach slope on the Gulf of Mexico coast near Fort Walton Beach, Florida: the swash zone, the mid-foreshore, and the area near the berm scarp. Under adiabatic and onshore wind conditions, it was found from the roughness ratios that the swash zone is approximately 100 times smoother than the mid-foreshore and 500 times smoother than the area near the berm scarp; the stress ratios revealed that the shear stress is approximately 2.5 and 3.5 times larger at 10 m and 20 m fetch downwind, respectively, from the swash zone. It is concluded that the stress ratios measured from the transition from smooth to rough on the beach are in fair agreement with those predicted by Panofsky and Townsend [1964]. — Author's abstract

00694 **Hu, Chung-Hung.** Ontogeny and sexual dimorphism of lower Paleozoic Trilobita: Palaeontographica Americana, v. 7, no. 44, p. [27]-155, illus., 1971.

In this study, 24 species (8 new) in 24 genera (4 new) of Lower Cambrian-Upper Orodivician trilobites are described; all but two are from North America. Excellent ontogenetic sequences are described for 23 species; 10 species show distinct bimodalism of adults, here attributed to sexual dimorphism — the 'females' have a larger body, without distinct prosopon, and are less numerous than the 'males.' Ontogenies of trilobites and living polychæete annelids, crustaceans, and xiphosurans are compared; similarities of cephalization and the generalized nature of trilobite appendages suggest that trilobites originated from polychaetes and may be related more closely to crustaceans than to xyphosurans. Trilobites other than agnostids are differentiated into four groups based on degree of separation of librigenae and rostrum; agnostids represent an architrilobitoid group, that deserves taxonomic rank equal to Trilobita. — VMJ

00970 **Hubbard, Norman J.** Some chemical features of lavas from the Manu'a Islands, Samoa: Pacific Sci., v. 25, no. 2, p. 178-187, illus., tables, 1971.

The lavas of the Manu'a Islands have chemical compositions typical of oceanic island alkali lavas. They have rare earth abundances with chondrite normalized lanthanum:ytterbium ratios around 10 and ytterbium concentrations about 2.2 ppm. Strontium concentrations are greater than 400 ppm and within the range of strontium values for Hawaiian alkalic lavas. Potassium:rubidium are about 700, suggesting heterogeneity of source materials. The Sr-87:Sr-86 ratios average 0.7046 ± .0003,

and are the highest known for oceanic islands. Low pressure differentiation is controlled by olivine and plagioclase. These lavas were segregated from a normal oceanic upper mantle at > 40 km depth, and the percentage of partial melting was in the range of 3 to 7 percent. The chemical composition of the probable original magma is established using combined trace element, major element, and partition coefficient data. — *from* Author's abstract

00778 **Huckenholz, H. G.; Yoder, H. S., Jr.** Andradite stability relations in the $CaSiO_3$-Fe_2O_3 join up to 30 kb: Neues Jahrb. Mineralogie Abh., v. 114, no. 3, p. 246-280, illus., tables, 1971.

The maximum stability limit of andradite has been determined in 1 atm of air, in excess O_2 up to 30 kb, and in the presence of excess H_2O and O_2 up to 20 kb. The results confirm that andradite has a much larger field of stability than revealed by its most abundant occurrences in nature. Its absence in peridotites, eclogites, and amphibolites is most likely the result of low oxygen fugacity in upper mantle and crustal basalts. Andradite is a primary phase in shallow intrusions of the syenite and nepheline syenite family or their volcanic equivalents. Its formation is favored in felsic differentiates of the alkalic rock suite. — DBV

Huff, Lyman C. *See* MacKevett, E. M., Jr. 00685

00822 **Hughes, G. M.; Landon, R. A.; Farvolden, R. N.** Summary of findings on solid waste disposal sites in northeastern Illinois: Illinois Geol. Survey Environmental Geology Notes, no. 45, 25 p., illus., 1971.

An investigation of the hydrogeology and geochemistry of five landfills in northeastern Illinois was made to develop guidelines that could be used to evaluate the pollution potential of existing and proposed landfill sites; some of the data from the study were published previously [ibid., nos. 26, 27, 1969]. Well points and piezometers were installed around and below existing landfills to determine the pattern of groundwater flow, and samples of ground water gathered from selected points were analyzed. Data were collected on the composition of dissolved solids in water draining from refuse and on attenuation of various dissolved solids in leachate as it moved away from the disposal site. Data suggest that large areas of northeastern Illinois could be used for solid waste disposal without affecting ground water. Methods of designing and operating landfill facilities in various hydrogeologic environments were suggested by the study. — GDC

00668 **Hughes, T.** Convection in polar ice sheets as a model for convection in the Earth's mantle: Jour. Geophys. Research, v. 76, no. 11, p. 2628-2638, illus., table, 1971.

Vertical temperature gradients lead to density inversions in polar ice sheets, which may lead to thermal convection. Conditions necessary to initiate and maintain thermal convection in ice sheets are examined. Available data indicate that critical Rayleigh numbers for convection can be attained by dislocation creep (strongly dependent on grain size), but not by diffusion. At the central ice divide no grain fabric should exist prior to convection; once begun, convection flow should create a favorable fabric in this region and, therefore, reinforce itself. Having no phase changes and being heated from below, polar ice sheets resemble a simplified, miniature mantle, and can duplicate boundary conditions imposed on the mantle by convection models. Convection appears possible for ice thicknesses, which may or may not require basal melting; this is analogous to mantle convection which may or may not extend to the Earth's fluid core. — *from* Author's abstract

Huneke, J. C. *See* Podosek, F. A. 00896

08341 **Hunsucker, John K.; Shoffner, Joseph E., Jr.** Ground-water levels in North Carolina in 1963-64: North Carolina Div. Ground Water Ground-Water Circ. 13, 56 p., illus., tables, 1970.

This report is a compilation of basic data on water-level fluctuations in 49 observation wells in North Carolina for the period 1963-64. Eleven wells were equipped with

recording gages, 6 had weekly readers, 1 had a daily reader, and 31 were measured periodically. Basic data for each well is the mean water level and is shown by recorder graph or periodic tape measurements (tabulated). Total monthly precipitation is shown on hydrographs by bar graphs. The well-numbering system is explained. Ground-water occurrence is described briefly. — VSN

Hunter, J. A. *See* Killeen, P. G. 00701

00784 **Hurlbut, Cornelius S., Jr.** Dana's manual of mineralogy, 18th edition: New York and London, John Wiley and Sons, 579 p., illus., tables, 1971.

The general organization of this edition remains the same as in the past with major sections on crystallography followed by physical, chemical, and descriptive mineralogy. A short account of space groups is included in the crystallography section, and optical properties material is in the physical mineralogy section. The chemical mineralogy section includes a return to chemical and blow pipe tests for elements but with major emphasis on crystal chemistry. Descriptions are given of 200 minerals with the following crystallographic data included: interfacial angles for crystals; space group data; unit cell dimensions; axial ratios for nonisometric minerals; and δ spacings for the five strongest lines of the X-ray powder photograph. Indices of refraction and other optical properties are also included in mineral descriptions. — VSN

00923 **Hutchinson, Robert.** Awere, a new L4 chondrite fall: Meteoritics, v. 6, no. 1, p. 53-55, table, 1971.

On July 12, 1968, a meteorite fell near Awere, Omoro County, Uganda; detonations accompanied the fall. A thin-section and a polished thin-section made from a piece show that the meteorite is gray with various types of lighter and darker chondrules, which have well-defined margins, and are set in a fine-grained silicate groundmass. Partial analyses of olivine and pyroxene, the two most abundant minerals, are tabulated. — ESL

08385 **Hutchison, Harold C.** Map of southwestern Indiana showing locations of active coal mines: Indiana Geol. Survey Misc. Map 7, scale about 1 in to 6 mi, revised 1970; originally published 1962.

08364 **Hydrologic Data Branch.** Ground water in Ontario, southeastern area, 1960 to 1964: Ontario Water Resources Comm. Ground Water Bull. 2-8, 307 p., illus., tables, 1970.

Basic ground-water data in southeastern Ontario for the period 1960-64 are tabulated. Tables include precipitation data for selected localities, observation wells measured during the period, and summary of water-well drilling data for each year. Appendices give tabulations of observation wells and water-level measurements, licensed drilling and boring contractors records for water wells drilled, and previous reports in the series. Brief descriptions are given of the topography, climate, drainage, bedrock and surficial geology, and ground-water occurrence and source, regional aquifer characteristics, and surveys and investigations of the ground water. — VSN

Hyndman, R. D. *See* Cochrane, N. A. 08139

Iacconi, P. *See* Keller, P. 00675

08222 **Ichiye, Takashi.** Marine geological and geophysical research and exploration, Chap. 5 *in* UnderSea Technology Handbook Directory 1970: Arlington, Va., Compass Publications, p. A41-A56, illus., 1970.

Major exploratory cruises in the world oceans, vessels, and sponsoring institutes are summarized briefly; equipment, instruments and seismic techniques currently in use in submarine exploration are reviewed; and significant results obtained in the years 1967-69 in the Atlantic, Pacific, and Indian Oceans are discussed. A reference list of 154 items is appended. — VSN

Ikola, R. J. *See* Austin, G. S. 08291

Imbrie, J. *See* Klovan, J. E. 00990

08324 **Indiana Geological Survey.** Map of Indiana showing bedrock geology: Indiana Geol. Survey Misc. Map 16, scale about 1 in. to 30 mi., section, 1970.

00846 **Ingamells, C. O.; Suhr, N. H.; Tan, F. C.; Anderson, D. H.** Barium and strontium in silicates — A study on the development of analytical methods [with French and German abs.]: Anal. Chim. Acta, v. 53, no. 2, p. 345-360, illus., tables, 1971.

Two X-ray fluorescence procedures were used; one involves fusion with lithium metaborate and yields only strontium values. The other uses a direct dilution technique and gives results for both barium and strontium. Strontium can be satisfactorily determined by atomic absorption spectrometry in whole-rock solutions, but there are difficulties in determining barium in this way. Emission spectrometry, with a spark-solution technique and automated equipment, gives rapid and accurate results for both barium and strontium. Flame emission spectrometry, neutron activation analysis, and classical gravimetric methods are not satisfactory as routine methods for barium and strontium in silicate rocks. Barium and strontium may be satisfactorily determined, by several methods, and refinement of these methods is possible to the point where sampling error, rather than analytical error, may often determine variance in the results. — *from* Authors' summary

08156 **International Atomic Energy Agency.** Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, 384 p., illus., tables, 1970.

Recent estimates of the future expansion of nuclear power are such that there will be an increasing demand for uranium over the next decades. Since the time interval between discovery of a major deposit and production, is more than five years, it is important that a high level of exploration be maintained throughout the 1970's. The introductory review and descriptive summaries of 12 uranium deposits are given, of which four are cited separately from the paper. Of six papers on favorability criteria, three are cited separately. The final 20 pages are devoted to reports of five Working Groups. — ESL

08128 **Irvine, T. N.** Heat transfer during solidification of layered intrusions — [Pt.] 1, Sheets and sills: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1031-1061, illus., tables, 1970.

With the advent of crystal settling in a solidifying igneous intrusion, the roof contact may be continuously subjected to temperatures approaching those of the magma itself. This causes steeper gradients in roof rocks and a more rapid heat loss and solidification than would occur were the crystals frozen to the roof. By contrast, accumulation of crystals in lower parts lowers floor contact temperature and reduces gradients in the floor rocks, but because of liquid reduction, the overall effect is to speed solidification. The paper reviews qualitatively the relation between crystallization mechanisms and the temperature in the magma when crystal fractionation is a major process. — HRC

08114 **Irving, E.** The Mid-Atlantic Ridge at 45°N — [Pt.] 14, Oxidation and magnetic properties of basalt; review and discussion: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1528-1538, illus., table, 1970.

Magnetic properties of submarine basalts are attributed to two processes: the rapid quenching of the lava in axial zone of accretion produces dispersed titanomagnetite of very small grain-size, and during the quenching the lava acquires an intense and stable remanent magnetism. The oxidation state is initially low but is chemically unstable and undergoes secondary oxidation so that at 10 km from the accreting margin, the FeO/Fe_2O_3 ratio has fallen to about unity, the remanance has decreased by a factor of ten, and the Curie and blocking temperatures have risen. These magnetic changes may be caused by mild hydrothermal activity in the axial zone, and the larger magnitude of the axial geomagnetic anomaly compared to those on either side is at-

tributed to this oxidation process. Because of quenching and low initial oxidation state, sulfide minerals are generally present in the submarine basalts which therefore may be a potent source of sulfide mineralization. — *from* Author's abstract

Irving, E. *See* Park, J. K. 08167

Irving, E. *See* Brooke, J. 08168

08262 **Irwin, R. W.** Soil water characteristics of some Ontario peats [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 219-223, illus., tables, 1970.

Investigations of physical properties of reclaimed peat soils from 7 commercial agricultural areas in Ontario show the variations between these soils to be small. Problems in sampling are discussed. Field measurements were made to determine the saturated in situ hydraulic conductivity. The average value of 5.7×10^{-4} cm/sec is less than many fine grained mineral soils. There were significant differences in vertical and horizontal hydraulic conductivity. Laboratory measurements were made to determine specific gravity, ash content, bulk density, void ratio, permeability and porosity. The water retention characteristic curve shows that peat soils yield water slowly as tension is increased. — Author's abstract

00885 **Isphording, Wayne C.; Lamb, George M.** Age and origin of the Citronelle Formation in Alabama: Geol. Soc. America Bull., v. 82, no. 3, p. 775-779, illus., table, 1971.

The Citronelle Formation occurs along the southern margin of the Coastal Plain and can be traced from Texas across the Gulf Coast into peninsular Florida. The formation has been the subject of a heated age controversy since it was first described in 1916. At present, its age is given by various investigators as late Miocene, Pliocene, Plio-Pleistocene, or Pleistocene. The recent discovery of abundant vertebrate fossils in northern Mobile County, Ala., near the base of the formation, indicates that the maximum age is mid-Pliocene (Hemphillian). Hence, the faunal evidence, coupled with existing pollen data from the upper sediments of the Citronelle in nearby Florida, now indicates that deposition began in the middle Pliocene and continued into the pre-Nebraskan Pleistocene. — *from* Authors' abstract

Jacob, C. E. *See* Saleem, Z. A. 00654

08260 **Jacob, H.; Koch, J.** Application of coalpetrologic methods in peat research [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 201-205, illus., 1970.

For the purpose of investigating the constituents of coal and peat that are called "macerals", thin polished sections can be used. In the mode of illumination, primary consideration should be given to bright field and luminescence. Three maceral groups are distinguished in brown coal (and peat) petrology, namely, liptinite, huminite and inertinite. Liptinite is predominantly polymeric bituminous plant substances, and the two other groups are predominantly humic substances which owe their different reflectivity to different conditions of degradation. The micro-reflectivity of the macerals can be measured photo-electrically. Statistical analysis facilitates the determination of the frequency distribution and thus of the distribution of material groups. This would require approximately 500 to 2,000 measurements. A prerequisite would be to have available an electronic data logger and data processing device. — Authors' abstract

00955 **Jacobs, J. A.** Reversals of the Earth's magnetic field: Nature, v. 230, no. 5296, p. 574-575, illus., 1971.

It has been proposed that wobble of the dipole axis around the rotational axis is an expression of asymmetric motion in the core, and that this provides a mechanism for geomagnetic reversals. This paper estimates how close the dipole axis would have to come to the rotational axis to initiate the sequence of events leading to a polarity

reversal. If the assumptions underlying the calculation are realized in the Earth, then it would seem that if the dipole axis approaches the rotational axis to within about 0.5°, a reversal is likely to occur. — DBV

08298 **Jahn, Alfred.** Soil movements under the influence of freezing [with French abs.] *in* Ecology of the subarctic regions, V. 1 *of* Ecology and conservation — A symposium, Helsinki, 1966, Proc.: Paris, UNESCO, p. 119-123, 1970.

Polygonal soils, which form where segregation of mineral matter and soil fractures are caused by soil movement, have no vegetation cover. Soil movement is caused by the direct action of temperature (freeze and thaw), of pressure of frozen soil on non-frozen soil, and of gravity. Movements due to freeze-thaw are a result not only of climate but of local soil conditions such as morphology, geology and, especially, hydrology. The influence of soil movements on vegetation is due to direct mechanical action, the continuous seasonal uplift and subsidence of soil by freezing and thawing, and to indirect action by single movements, such as that of injection ice or thermokarst processes. All these movements weaken plant roots and make vegetation susceptible to destruction by wind action. — EH

00638 **James, Allan H.** Hypothetical diagrams of several porphyry copper deposits: Econ. Geology, v. 66, no. 1, Bateman issue, p. 43-47, illus., 1971.

A general model of a porphyry copper deposit can be constructed by piecing together evidence from four deposits: Ray and Chino represent Precambrian and Paleozoic host rocks, respectively, in a zone deeper than that of Bingham Canyon, and Braden represents a sulfide stock work in andesite flows above the level at which a major intrusive might be exposed. "Mineralization appears to crosscut the regional host and upper consolidated portions of the complex melt from which it was probably derived. Deeper primary copper concentrations are found in 'skirts' of mineralization extending downward." — WSW

00912 **Jansen, G. J.; Schieltz, N. C.** Delafossite $CuFeO_2$ from the Kirwin mineralized area, Wyoming: Mineralog. Record, v. 2, no. 1, p. 4, table, 1971.

This uncommon copper mineral has been found in the southern Absaroka Mts. in Park County. Early Tertiary volcaniclastic and volcanic rocks are intruded by granodiorites and andesites, forming a porphyry copper-molybdenum deposit. Delafossite occurs as a velvety black meterial filling indentations in the oxidized zone. X-ray powder diffraction data for Kirwin, Bisbee, and ASTM delafossite are compared. — ESL

08372 **Janssens, A.** Guidebook to the Middle Devonian rocks of north-central Ohio — Ohio Geological Society field trip, May 15, 1970: [Columbus, O.] Ohio Geol. Soc., 30 p., illus., tables, 1970.

Middle Devonian rocks examined in five quarries between Columbus and Lake Erie, with emphasis on the basal portion, have northward changes in both thickness and lithology. At the first stop are exposed two-thirds of the Delaware Limestone thickness and the entire underlying Columbus Limestone, with no evidence for disconformity between its fossiliferous upper and dolomitic lower beds, and the Detroit River Group (first known as the Monroe). Correlation with the Dundee Limestone in northwestern Ohio is revised, as is a pinch-out concept for the Detroit River beds. The latter, dated until 1920 as Silurian, are now accepted as a facies of the Columbus; the boundary coral zone descends rapidly eastward in subsurface, and persists into Lorain County, where it rests directly on Bois Blanc(?) beds. Measured quarry sections and general descriptions of Lorain County cores drilled to test for salt are presented. — GDC

00922 **Jarosewich, Eugene.** Chemical analysis of the Murchison meteorite: Meteoritics, v. 6, no. 1, p. 49-52, table, 1971.

In the past two years the Smithsonian Institution has obtained seven meteorites that have been observed to fall. The Murchison meteorite is a rare type II carbonaceous

chondrite. Enough material has been recovered to assure diversified studies. The meteorite fell Sept. 28, 1969, near Murchison, Victoria, Australia. Some fragments were collected immediately after the fall and others after a heavy rain. It is very similar to the Murray as shown in a table of the chemical analyses; closest of any two type II carbonaceous chondrites. The low sodium content of both is markedly different from the rest. — ESL

Jarosewich, Eugene. *See* Levi-Donati, G. R. 00984

08415 **Jenkins, W. A. M.** Chitinozoa, *in* Perkins, B. F., editor, Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, p. 1-21, illus., 1970.

Chitinozoans are bottle-shaped microfossils with hollow, organic-walled tests. They thrived during Ordovician, Silurian, and Devonian and were exclusively marine. Tests occur singly, in chains, and in clusters within organic cocoons. They may represent only parts of life cycles having planktonic and benthonic stages. Several conflicting opinions about chitinozoan affinities have been published, yet the group's systematic position remains unknown. The hypothesis is ventured here that chitinozoans are like reproductive bodies of graptolites. Their usefulness in stratigraphy is enhanced by rapid evolution, wide diversity of form, and the short vertical ranges of many species. Lateral distributions of species are apparently independent of minor changes and many species are known from a wide variety of depositional environments. Numerous species are widely distributed on one or both sides of the North Atlantic. — *from* Author's abstract

00857 **Jensen, H. M.; Klausing, R. L.** Geology and ground water resources of Traill County, North Dakota — Pt. 3, Ground water resources: North Dakota Geol. Survey Bull. 49, 40 p., illus., tables, 1971.

Ground water in Traill County is obtainable from sand and gravel deposits associated with Pleistocene glacial drift and from sand and (or) sandstone beds in the Dakota Group of Late Cretaceous age. Principal aquifers are the Dakota, Hillsboro, Galesburg, Elk Valley, and Belmont aquifers. The Dakota aquifer, the largest and most productive in the county, yields more than a million gallons of highly mineralized water per day. The Hillsboro and Galesburg aquifers offer the most potential for future development; individual well yield from these two aquifers may be as much as 500 and 250 gpm, respectively. Aquifers of less importance are present in glacial drift, are relatively thin and of small areal extent, and yield adequate supplies for average domestic and livestock uses. — *from* Authors' abstract

08137 **Jensen, O. G.; Ellis, R. M.** Wave propagation in a horizontally-layered crust in terms of linear system theory: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1185-1193, illus., table, 1970; erratum, v. 8, no. 3, p. 309, 1971.

Elastic wave propagation in a horizontally-multilayered crust has been formulated in terms of linear systems theory. Exact linear system models, considering all possible internal reverberations, have been obtained for plane compressional and rotational waves incident at the base of a horizontally layered elastic medium. The linear system has been analyzed using Laplace and Fourier transform techniques. The Fourier transform solution corresponds to the Haskell matrix solution in terms of the elastic wave equations. The method has been extended to analyze the effects of attenuation within the crustal layers. — Authors' abstract

08337 **Jiménez Salas, José A.; Rodriguez Ortiz, José M.** (editors). Proceedings of the International symposium on Rock mechanics [2d], Madrid, 1968: Madrid, Spain, Soc. Española de Mecánica de Rocas, 422 p., illus., tables, 1970.

The theme chosen for this symposium was 'determination of the properties of rock masses in foundations and observation of their bahavior.' Discussions were divided into four sessions: determinations of deformation of rock masses; mechanical resistances; observation of displacements, deformations and stresses in foundations; and permeability, uplift pressure, and seepage discharges. Papers by the following

North American participants are cited separately: Barry Voight, C. Fairhurst, and William R. Judd. — VSN

Johnsen, S. J. *See* Dansgaard, W. 08209

00819 **Johnson, A. I.; Moston, R. P.** Relationship of consolidation characteristics and Atterberg limits for subsiding sediments in central California, U.S.A. [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 579-587, illus., table [1971].

Laboratory analyses on undisturbed cores of sediments in subsiding areas of central California indicate that the Terzaghi-Peck equations, relating compression index on coefficient of consolidation to liquid limit, do not hold for sediments tested. The compression index could be estimated from liquid-limit data but the relation was different for each area of subsidence. Comparison of compression indices obtained from consolidation curves with indices computed from liquid limits showed better correlation for sediments of alluvial lacustrine origin than for those of marine origin. Equations for the relation were obtained by computer solution of data trends. In all subsidence areas the coefficient of consolidation decreased with increasing values of liquid limit. The relation could not be estimated accurately because the coefficient for any particular load range varies more than one order of magnitude for any liquid limit. — *from* Authors' abstract

08367 **Johnson, Arvid M.** Physical processes in geology: San Francisco, California, Freeman, Cooper and Company, 577 p., illus., tables, 1970.

This textbook is an introductory course on methods of applying mechanics to solution of geologic problems, and, as such, presents the rheological approach to mechanical processes. The text is in three parts: Part 1, Flexures, introduces mathematical techniques to solve problems in formation of flexures. Part 2, Patterns of faults, joints, and dikes, develops the meaning of Mohr's Circle, discusses polar coordinates, criteria of fracture, method of calculating patterns of stresses in an elastic body, concepts of initial stress, and lack of knowledge about formation process of joints and faults. Part 3, Flow of ice, lava, and debris, examines marked similarities among patterns of flow and depositional products of ice, lava, and mud and shows how they can be explained in terms of mechanical behavior. — VSN

Johnson, G. L. *See* Schneider, E. D. 08356

Johnson, Gerald H. *See* Goodwin, Bruce K. 08316

00869 **Johnson, Howard A.; Bredeson, D. H.** Structural development of some shallow salt domes in Louisiana Miocene productive belt: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 204-226, illus., table, 1971.

Studies of six shallow salt domes show that structural growth was contemporaneous with sediment deposition. Physical properties and their differences in the 15,000 feet of interbedded sandstone and shale, underlying shale with abnormally high pore pressures and salt partly determines geometry of the salt structures. Cores of structures are salt or salt and high-pore-pressure shale. Core shale moved and was emplaced as "sheath" by folding or folding plus shearing. — EGS

Johnson, J. *See* Park, I. 00898

Johnson, Nyra A. *See* Frank, J. F. 08381

00779 **Johnson, W. Hilton.** Old glacial drift near Danville, Illinois: Illinois Geol. Survey Circ. 457, 16 p., illus., table, 1971.

Recent excavations in the Harmattan Strip Mine at Danville, Ill., expose an older Pleistocene till which is here named the Hegeler Till Member of the Banner Formation. An overlying fossiliferous silt and a clay are here named the Belgium Member and also included in the Banner Formation. Both units are assigned to the Kansan Stage [and are described]. — *from* Author's abstract

Jordan, Hanspeter. *See* Bless, Martin J. M. 00988

Jordan, T. H. *See* Kamb, Barclay. 00612

Jordan, Thomas H. *See* Hanks, Thomas C. 00644

Joyner, William B. *See* Warrick, Richard E. 00618

08339 **Judd, William R.** Rock mechanics observations [with French and German abs.], *in* International Symposium on Rock Mechanics [2d], Madrid, 1968, Proc.: Madrid, Spain, Soc. Española de Mecánica de Rocas, p. 255-262, illus., 1970.

The lack of a reliable theory to predict behavior of a rock system as an assembly of elements is emphasized. The empirical approach makes it possible to obtain practical success in many problems. Systems analysis aided by high speed computer calculations, is an excellent tool to solve important civil engineering problems. The procedure adopted by the U.S. Bureau of Reclamation evaluates shear strength of a rock system through radial jacking and in situ shear tests. Many other research problems have been raised by the new very high dams, especially the interaction between arch and rock abutments. Seismic action on dams is discussed, and it is pointed out that very few quantitative data are available; studies by the Bureau of Reclamation for the Auburn Dam are cited. It is concluded that more accurate and reliable prediction theories based on strain or deformation studies and not on 'stresses' are necessary. — VSN

08318 **Judge, C. W.** Heavy minerals in beach and stream sediments as indicators of shore processes between Monterey and Los Angeles, California: U.S. Army Corps Engineers Coastal Eng. Research Center Tech. Memo., no. 33, 44 p., illus., tables, 1970.

Five heavy mineral provinces have been identified along the coast of California from a study of sand samples: northern hornblende province from north of Monterey Bay to Piedras Blancas Point, northern augite province from Piedras Blancas Point to Avila Beach, epidote province from Avila Beach to Ventura, southern augite province from Ventura to Palos Verdes Point, and southern hornblende province from Point Fermin south. A southward littoral transport north of Point Conception is indicated by ratios of less stable augite and hornblende to more stable garnet and zircon, and also south of Ventura and Santa Clara Rivers as indicated by increase in grain sizes and in augite and hornblende content. Heavy minerals are not definitive indicators of littoral drift from Point Conception to Ventura, but it can be concluded that, although Point Conception-Point Arguello act as a partial barrier, some sand moves south and east around them. — VSN

00614 **Jungels, Pierre; Anderson, Don L.** Strains and tilts associated with the San Fernando earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 77-79, illus., 1971.

Analysis of strain- and tiltmeter records indicates that both components of strain recorded at Isabella (Calif. Inst. Technology) and the Nevada Test Site exhibit release of compression, and those recorded at Univ. of California San Diego, tensional release. This agrees with the fault-plane solution for the main shock and with field observations of surface faulting. A crude estimate of the expected strain field is obtained by combining theoretical strains for strike-slip and dip-slip motion for each of the three sites; results are in good agreement with observations. Principal aftershocks line up along the compression release axis and along the southeast nodal axis, and the strike of the original break closely parallels the closest segment of the San Andreas fault. The earthquake decreased the elastic compressional stress across the San Andreas by 2×10^{-6}; it occurred very close to the time of maximum tidal compressional strain. — VSN

00606 **Kachadoorian, Reuben.** An estimate of the damage, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 5, table, 1971.

The cost of the San Fernando earthquake may reach three-fourths of a billion dollars when all factors are taken into consideration, including loss of employment and loss of revenue from taxes and change in the tax base. A total of 180 schools were damaged, 18 so severely that they were abandoned; two hospitals sustained major damage and partial collapse and will have to be replaced; 21,761 private homes were damaged, of which 465 were declared unsafe; 62 apartment houses and 372 commercial structures were also declared unsafe; damage to highways and roads amounted to 22.5 million dollars; five dams were damaged; numerous structures owned by the city and county of Los Angeles, city of San Fernando, State of California, and the Federal Government were damaged; and repairs to water, sewer, electrical and telephone facilities will amount to about 42 million dollars. — VSN

00744 **Kahle, J. E.; Barrows, A. G.; Weber, F. H., Jr.; Saul, R. B.** Geologic surface effects of the San Fernando earthquake: California Geology, v. 24, nos. 4-5, p. 75-79, illus., 1971.

Surface breaks by faulting during this earthquake extend for about 12.5 mi from Bee Canyon area of the Santa Susana Mts. eastward across the San Fernando-Sylmar area in northern San Fernando Valley to Big Tujunga Wash in the Sunland area. Most breaks are surface expressions of thrust faulting whereby land on the northern sides of breaks was thrust obliquely southwest. The most spectacular line of breaks extends from near the intersection of Hubbard and Glenoaks Blvd. in Sylmar, eastward across a residential area of San Fernando, across the new Foothill Freeway to the San Fernando Industrial Park, and then eastward; breaks are well exposed across mouths of Lopez, Kagel, and Little Tujunga Canyons. Several areas of breaks are described and illustrated in pictures, and locations are shown on a map. — VSN

Kahn, J. S. *See* Crowley, B. K. 00721

08355 **Kalsbeek, Feiko; Leake, Bernard E.** The chemistry and origin of some basement amphibolites between Ivigtut and Frederikshaab, south-west Greenland: Grönlands Geol. Undersögelse Bull., no. 90, 36 p., illus., tables, 1970; Medd. Grönland, v. 190, no. 4, 1970.

Chemical and modal analyses of 54 amphibolites, 5 biotite gneisses and 5 hornblende-biotite gneisses into which the amphibolites grade, confirm field and petrographic evidence that the amphibolites were probably basic tuffs and lavas which, when mixed with varying amounts of quartzo-feldspathic sediment, gave rise to hornblende-biotite gneisses upon metamorphism. In an alkali-silica diagram 34 samples fall in the field of tholeiite basalt and 20 in that of alkali basalt; traces of normative nepheline never exceeding 4 percent occur in only 10 samples. The sporadic occurrence of garnet and diopside and of up to 15 percent quartz are primarily controlled by original composition of samples. It is possible that the more quartzose and garnetiferous amphibolites formed from late differentiates of the original basaltic magma, but contamination with sedimentary material cannot be excluded. — *from* Authors' abstract

00612 **Kamb, Barclay; Silver, L. T.; Abrams, M. J.; Carter, B. A.; Jordan, T. H.; Minster, J. B.** Pattern of faulting and nature of fault movement in the San Fernando earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 41-54, illus., tables, 1971.

Data on the occurrence and amount of ground displacement by surface faulting was gathered within 4 days after the San Fernando earthquake in the area east of Sylmar and Olive View Hospital. Movement can be explained in terms of a single master fracture at depth, striking N. 72° W. and dipping about 45° N.; individual fault segments that moved at the surface, collectively forming the San Fernando fault zone, strike more nearly E-W and bear an en echelon relation to the master fracture. Overall fault motion was thrusting of the north side southwestward over the south side; it combined types of displacement characteristic of major faults of the Transverse Range province. Overall displacement was about 2 m. Most fracturing reached the surface 4 km south of the major tectonic feature in the area, the Sierra Madre fault zone, along relatively minor faults; these faults probably join the Sierra Madre a short distance to the east. — VSN

Kanamori, H. *See* Takeuchi, H. 08285

08350 **Kapp, Ronald O.** A 24,000-year-old Jefferson mammoth from Midland County, Michigan: Michigan Academician, v. 3, no. 2, p. 95-99, illus., 1970.

The radiocarbon date (24,000 ± 4,000 yr B.P.) on remains of a Jefferson mammoth recovered near Coleman in Midland County, Michigan provides evidence about the pre-Late Wisconsin interstadial interval in Michigan. The data suggest that the deposit is a correlative of Plum Point interstadial deposits in Canada and the Farmdalian interstadial of Illinois. The fossiliferous sediments were deposited by a stream; discontinuous deposition precludes the possibility of analysis and interpretation of plant macrofossils and pollen-bearing sediments. — Author's conclusion

00831 **Karcz, Iaakov.** Development of a meandering thalweg in a straight, erodible laboratory channel: Jour. Geology, v. 79, no. 2, p. 234-240, illus., 1971.

The following sequence of bed deformation leading to a development of a meandering stream path was observed in shallow flows along a straight laboratory channel molded in pumice: appearance of far-spaced bed undulations; appearance of flow-aligned scours at the leeward ends of the undulation crests; growth and spread of the scours and a gradual deformation of the surrounding stream bed into a thatched at offset pattern of scours with intervening mounds; growth and merging of scours along interconnecting sinuous paths; and rapid excavation along a preferred tortuous path and appearance of a pronounced meandering thalweg. These events may be interpreted as results of the inherent structure of the parent flow. — Author's abstract

00672 **Karig, Daniel E.** Origin and development of marginal basins in the western Pacific: Jour. Geophys. Research, v. 76, no. 11, p. 2542-2561, illus., tables, 1971.

Marginal basins lying behind island arc systems, believed to be of extensional origin, are underlain by oceanic crust; they can be divided into actively spreading inter-arc basins and older inactive basins. Inactive basins with above-normal heat flow apparently are younger than those with normal heat flow. Volcano-tectonic rift zones with associated silicic tuffs in some continental trench-arc systems may have been formed by similar extensional process. As the inter-arc basin opens the trench is forced to migrate, and the Benioff zone is flattened, except in areas where crust can be consumed in a trench behind the extensional zone. Active extension is limited to arc systems with earthquakes deeper than about 350 km. Available data can be explained by a thermal diapir of shear-heated mantle material rising beneath the inter-arc basin from the top of the underthrust lithosphere. — DBV

00764 **Karsten, Richard A.; Tuttle, Sherwood D.** The distribution of climatic factors in Iowa and their influence on geomorphic processes: Iowa Acad. Sci. Proc. 1970, v. 77, p. 266-281, illus., tables, 1971.

Using the two parameters of mean annual temperature and mean annual rainfall for 119 stations in Iowa, a scattergram was constructed. Statistical analyses of the data suggest the presence of three microclimatic zones or regions in Iowa — north-northwestern, central, south-southeastern — which are distinct in terms of climatic geomorphology. Comparisons of climatically controlled aspects of erosion and weathering showed that: drainage composition has had greater development in the south; climatic factors affect the distribution and transportation of the dissolved and suspended load in streams; soils of similar type and origin are more mature and have undergone more leaching of potassium, magnesium, and phosphorus in the southeast than in the northwest; employment of the universal soil loss equation suggests more soil removal per acre by erosion in the southeast than in the northwest. — *from* Authors' abstract

Kaufmann, H. E. *See* O'Donnell, J. E. 00631

Keen, M. J. *See* Park, I. 00898

08117 **Keen, M. J.** A possible diapir in the Laurentian Channel: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1561-1564, illus., 1970.

Seismic reflection studies in the Laurentian Channel have located a structure, which may be a diapiric salt intrusion, at 45°12′ N, 57°07′ W. It occurs over the eastern end of a part of the region of low, free-air gravity anomalies, which extends from eastern Nova Scotia. It is reasonable to suppose that the structure is a diapiric salt intrusion; evaporites have been reported in one drill hole to the east, on the Grand Banks. If so, this confirms the interpretation of the gravity anomalies by Loncarevic and Ewing. A reflection profile across the whole channel does not support the view that the present form of this part of it is of structural origin. — Author's abstract

08152 **Keen, M. J.** Fracture zones on the Mid-Atlantic Ridge between 43 °N and 44 °N: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1352-1355, illus., 1970.

A seismic reflection profile across the fracture zones on the Mid-Atlantic Ridge between 43°N and 44°N shows that the thickness of sediment increases markedly south of the fracture zone at 43°05′N on the eastern flank of the ridge. The thickness there is in accord with observations made west of the ridge in the region of the survey at 45°N. This suggests that the effects of rates of sea-floor spreading and sedimentation have been similar on this eastern part of the ridge to those west of the ridge farther north. — Author's abstract

08243 **Keene, P.; Zawodniak, C. D.** Embankment construction on peat utilizing hydraulic fill [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 45-50, illus., 1970.

A recent project in Connecticut involved the pumping and placement of substantial quantities of sand as hydraulic fill over compressible peat deposits to form a large highway embankment. Initial thickness of the peat varied from 10-25 ft. The roadway level extended 25 ft above the swamp, with an additional 10 ft of temporary overload being utilized. Controlled rates of filling were specified. Peat response to filling was measured by field instrumentation. Analyses of these data compared favourably with theoretical analyses based upon laboratory tests, to establish basic performance values. Settlements to date are approximately 60 percent of the original peat thickness. Approximately 300,000 dollars was saved by utilizing this "floating" technique rather than conventional excavation of peat and replacement with granular material. — Authors' abstract

Kehlenbeck, M. M. *See* Wynne-Edwards, H. R. 08121

00718 **Kehn, Thomas M.** Geologic map of the Greenville quadrangle, Muhlenberg County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-907, scale 1:24,000, sections, text, 1971.

Bedrock is of Mississippian-Pennsylvanian age. Structure contours on the base of the No. 9 or No. 4 coal beds or the Kinkaid Limestone are included. Coal, gas, and oil are the important mineral resources. — ESL

00911 **Keidel, F. A.; Montgomery, A.; Wolfe, C. W.; Christian, R. P.** Calcian ancylite from Pennsylvania — New data: Mineralog. Record, v. 2, no. 1, p. 18-25, 36, illus., tables, 1971.

New data have been obtained for ancylite, an orthorhombic hydrated basic carbonate of strontium, calcium, and the cerium group of rare earths, from Cornog, Chester County, Pa. The refractive indices are: $\alpha = 1.654$, $\beta = 1.733$, $\gamma = 1.772$, birefringence 0.118, biaxial negative with $2V = 60°$-$70°$. Unit cell dimensions from X-ray photographs are: $a = 4.97$, $b = 7.24$, and $c = 8.50$A. Color effects are due to characteristic lanthanide absorption bands. — *from* Authors' abstract

00983 **Keller, Edward A.** Areal sorting of bed-load material — The hypothesis of velocity reversal: Geol. Soc. America Bull., v. 82, no. 3, p. 753-756, illus., 1971.

Stream-bed materials commonly show distribution of larger fragments in riffles and finer (sand and silt) materials in pools. Current-meter measurements in Dry Creek, Calif., show that with increasing discharge, bottom velocity increases faster in the pools than in the riffles until at fairly high flows, velocity on pool bottoms exceeds

that in riffles. This condition reverses the velocity distribution that prevails at lower discharges, and seems adequate to explain the bottom-material distributions observed. Coarser materials are deposited in riffles and on bars at flows exceeding the reversal velocity, and fines are deposited in pools at flows below the reversal velocity. The areal sorting observed seems to have a recurrence interval of between 1 and 2 years. — JHF

Keller, O. A. *See* Gates, J. S. 08370

00675 **Keller, P.; Lapraz, D.; Iacconi, P.** Description d'un appareillage destine a l'étude de la thermoluminescence cristalline entre 20°C et 500°C [with English abs.]: Modern Geology, v. 2, no. 2, p. 71-74, illus., 1971.

The authors describe an apparatus which permits recording of the thermoluminescence emitted by various crystalline materials, with a high degree of reproductivity and sensitivity, from room temperature to 500°C. The heating rates are constant about one percent and may be varied from 0.1°C/s to 2°C/s. — Authors' abstract

00941 **Kelley, James C.** Multivariate oceanographic sampling: Jour. Internat. Assoc. Math. Geology, v. 3, no. 1, p. 43-50, illus., table, 1971.

The theory of linear programming provides plans for optimal sampling of geologic and oceanographic phenomena. Of particular significance are solutions to problems of multivariate sampling. Often, a single field sample may be analyzed for a number of oxides, or minerals, or textural parameters. In general, these variables differ in the degree to which they are diagnostic of changes in phenomenon of interest, and thus must be known with different levels of precision. Similarly, variables differ in ease with which they can be measured. If a sampling plan is to be most efficient, it must provide requisite levels of precision for minimum expenditure of time and effort. Sampling for a single variable may be optimized directly, for several variables simultaneously introduces difficulties, but if the objective function can be generalized to hold for all variables, solutions can be determined. — *from* Author's abstract

Kelly, William C. *See* Coveney, Raymond M. 08406

08404 **Kempe, D. R. C.; Deer, W. A.** Geological investigations in East Greenland — Pt. 9, The mineralogy of the Kangerdlugssuaq alkaline intrusion, East Greenland: Medd. Gronland, v. 190, no. 3, 95 p., illus., tables, 1970.

Minerals of Kangerdlugssuaq alkaline intrusion are systematically described, with 28 full analyses and additional partial and X-ray analyses. The main mineral, alkali feldspar, is low albite-orthoclase or low albite-microcline microperthite — Or_{38} in main pulaskite to nordmarkites, Or_{36} in transitional pulaskite, and Or_{41} in main pulaskite to Or_{55} in foyaite. Nordmarkites and transitional pulaskite contain phenocrysts of low albite-orthoclase microperthite. Both perthitic alkali feldspars are derived by unmixing from single feldspars of the anorthoclase-sanidine series. Temperatures of crystallization of feldspars and nephelines are in agreement. Pyroxenes are aegirines and aegirine-augites in pulaskites and veins, and in nordmarkites, pulaskites and veins, respectively. Biotite occurs mainly in pulaskites. Numerous accessory minerals are described and trace-element analyses of minerals and some rocks are presented. — VSN

Kennedy, Robert K. *See* Allen, William H., Jr. 00761

00865 **Kerr, Paul F.; Stroud, Robert A.; Drew, Isabella M.** Clay mobility in landslides, Ventura, California: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 267-291, illus., tables, 1971.

Landslides cover about 345 acres, or 45 percent, of the eastern producing area of Ventura Avenue oil field, California. In operations which extended over about 45 years to the end of 1969, 61 oil wells were destroyed by landslide activity, and 53 were returned to production. The landslides occur, for the most part, in massive

granular sandstones of the middle Pico Formation (Pliocene) which are intercalated at irregular intervals with clay-bearing strata. Clay strata are thin but contain substantial amounts of montmorillonite with some illite and minor content of kaolinite. The clay-water mixture probably is the most important factor, although slope, structure, and compaction require consideration. Several attempts have been made to control the slides. — *from* Authors' abstract

Kesling, Robert V. *See* Sigler, James P. 00782

00977 **Kesling, Robert V.** *Antiquaster magrumi*, a new unusual brittle-star from the Middle Devonian Silica Formation of northwestern Ohio: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 10, p. 181-191, illus., tables, 1971.

A brittle-star [Ophiuroidea] from the Silica Formation is classified as a new genus and species of the order Stenurida. Transverse arm elements, interpreted as ambulacrals, sublaterals, and laterals, show elongation reminiscent of the somasteroids. On the other hand, the juxtaposition of ambulacrals and the form of the mouth frame are very similar to those in the order Oegophiurida. The unique combination of primitive and advanced characters provides the basis for a new family, the Antiquasteridae. — Author's abstract

00978 **Kesling, Robert V.** Arms of *Decadocrinus hughwingi* Kesling: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 11, p. 193-199, illus., 1971.

A topotype-hypotype specimen of *Decadocrinus hughwingi* Kesling, 1964, a crinoid from the Middle Devonian Silica Formation, northwestern Ohio, preserves extensive parts of the arms. The secundibrachials comprising each of the ten arms have the same basic pattern as other species of the genus: each brachial bears a stout pinnule of several segments; pinnules alternate left and right on the arm; each arm is a mirror image of the other in the same ray; the brachials are truncated wedge-shaped, larger at the side with the pinnule, so that the sutures zigzag. The vermiculate-striate ornamentation on the cup plates becomes smoother distally on the arms. Ambulacral cover plates are L-shaped with the outer ramus attached to muscles for opening and closing the groove, the closed plates somewhat imbricate, zipper-like. — *from* Author's abstract

00979 **Kesling, Robert V.** *Dolatocrinus kutasii*, a new crinoid from the Middle Devonian Bell Shale of Michigan: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 12, p. 201-211, illus., 1971.

A new crinoid species from the Bell Shale in Alpena County is the oldest *Dolatocrinus* found in the Middle Devonian Traverse Group of Michigan. It is characterized by a broad funnel-shaped basal pit, a lobate tegmen bearing high spines, and a relatively low cup. Ornamentation is dominated by high crested ridges from centers of RR to centers of the axillary $PBrBr_2$, spines at centers of $iBrBr_1$ where numerous low ridges converge, and a straight-sided pentagonal basal rim linking centers of RR; other ridges are relatively low. The new species shows similarities to immature specimens of *D. michiganensis* and to adults of *D. bulbaceous*. The holotype has 18 arms. —*from* Author's abstract

Kesling, Robert V. *See* Ehlers, George M. 08306

08348 **Khin, BaSaw.** Cornetite from Saginaw Hill, Arizona: Mineralog. Rec., v. 1, no. 3, p. 117-118, illus., 1970.

Cornetite, $Cu_3(PO_4)(OH)_3$, occurs in a copper prospect on the southern side of this hill southwest of Tucson, Ariz. There are a few known occurrences in Africa and Nevada, and its type locality is the L'Etoile du Congo mine in Katanga. At Saginaw Hill, it is associated with other oxide zone minerals, in well-crystallized but fine-grained soft clusters, which plaster fractured walls of quartz or chert gangue; it occurs as clear light peacock-blue soft crystal aggregates, and as darker blue or greenish blue, harder crystalline clots which frequently alter to pseudomalachite. The fracture zone along which the copper minerals are found contains fragments of

Cretaceous arkosic sediments, granodiorite, and vein quartz; mild low-temperature hydrothermal alteration is mainly silicification. The description of the cornetite includes crystal morphology, X-ray cell data, and optical properties. — GDC

Khoury, S. G. *See* Abdel-Khalek, M. Lofti. 00880

00701 **Killeen, P. G.; Hunter, J. A.** The application to hard rock mineral investigations of a portable seismograph with detectors adjustable for coherent reflections: Geoexploration, v. 9, no. 1, p. 27-33, illus., 1971.

An investigation to determine the suitability of a portable reflection seismograph in mapping rock type interfaces in the Canadian Shield involved the recording of approximately 5,000 feet of linear profile over the contact between Proterozoic basal conglomerates and Archean basic complex. In the interpretation, the multiple reflections which occur are removed from the field records, and reflecting horizons to depths of 1,100 feet have been identified, and these correlate well with the geological interpretation based on surface outcrop and drilling. The results of applying the seismic technique to this area, point the way to the wider use of the method to structural problems in mining exploration. — Authors' abstract

08129 **Killeen, P. G.; Carmichael, C. M.** Gamma-ray spectrometer calibration for field analysis of thorium, uranium and potassium: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1093-1098, illus., 1970.

The calibration of a portable three-channel gamma-ray spectrometer for *in situ* analysis of thorium, uranium, and potassium is discussed. A method of regression analysis is suggested as the best means of including all of the data available from the calibration stations. Calibration indicates a nonlinear relation between count rates obtained in the field and concentrations in parts per million obtained from laboratory analysis. The range of radioelement content must be taken into consideration and appropriate sets of calibration constants applied. As an example of the method, calibration constants are calculated for a portable gamma-ray spectrometer using data for the Blind River uranium region of Ontario. — Authors' abstract

00630 **King, Kenneth.** Ground-motion amplification and vibration measurements, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 155-156, table, 1971.

The Las Vegas Special Projects Party of the National Ocean Survey in cooperation with the Atomic Energy Commission installed and operated seismic instruments in the vicinity of the main epicenter of the San Fernando earthquake. Instrumentation is described, and locations of the stations for the following programs are given in a table: building and free field seismic measurements, Bank of California, Pacoima Dam comparison, ground motion amplification, and building vibration programs. — VSN

08126 **King, Lewis H.; MacLean, Brian.** Origin of the outer part of the Laurentian Channel: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1470-1484, illus., 1970.

Seismic-reflection profiling of the outer Laurentian Channel shows two significant sub-bottom surfaces: (1) a more or less smooth glacial pavement across Carboniferous, Cretaceous, and Tertiary(,) strata that conforms closely to the shape of the present sea floor; (2) an older irregular, erosional surface cut into Carboniferous and Cretaceous rocks. These channels are infilled with Tertiary sediments. It appears likely that the outer channel is essentially a product of subaerial and subsequent glacial erosion. It does not appear to be structurally controlled, nor does it appear to have been formed by turbidity currents. — *from* Authors' abstract

00684 **King, R. U.; Raymond, W. H.** Geologic map of the Scenic area, Pennington, Shannon, and Custer Counties, South Dakota: U.S. Geol. Survey Misc. Geol. Inv. Map I-662, scale 1:31,680, 1971.

Kinoshita, W. T. *See* Burford, R. O. 00615

Kirby, John R. *See* Zietz, Isidore. 00702

Kirby, S. H. *See* Burford, R. O. 00615

08378 **Kirk, Ruth.** The oldest man in America: New York, Harcourt Brace Jovanovich, Inc., 96 p., illus., 1970.

This is a popular account of archeological investigation of the Marmes rock shelter in Palouse Canyon in southeastern Washington. A team of archeologists, assisted by scientists from the U.S. Geological Survey, uncovered and reconstructed a sequence of more than 10,000 years of human habitation of the shelter. Bone fragments of Marmes Man were found in a stratum between lake deposits dated 13,000 yr ago and layers of mussel shells dated 9,000-11,000 yr ago; C-14 dates of about 10,000 yr ago were found for charcoal and bone fragments associated with the human bones. Archeological and geological techniques used in the exploration are described. — EH

Kirwan, R. W. *See* Glynn, T. E. 08252

Klausing, R. L. *See* Jensen, H. M. 00857

00652 **Kleinecke, David.** Use of linear programing for estimating geohydrologic parameters of groundwater basins: Water Resources Research, v. 7, no. 2, p. 367-374, table, 1971.

Simulation models of ground-water basins require that values be given for parameters such as permeability and storage capacity. At present these parameters are initially estimated and later adjusted by trial and error to improve the simulation of some known portion of water history. This process might be reversed to deduce geohydrology directly from the historical record. This suggestion was tested against a basin studied earlier in California, and the fitting criteria used gave rise to linear programing formulations, which were solved from basin data. The approach shows promise in that about one-third of the basin parameters were evaluated; further development is required. Historical records actually underdetermine the system because of redundancy effects. The approach is the best method known for estimating effective aquifer depth. — *from* Author's abstract

00796 **Klemme, H. Douglas.** The giants and the super giants: Oil and Gas Jour., pt. 1, v. 69, no. 9, p. 85-90; pt. 2, v. 69, no. 10, p. 103-107, 110; pt. 3, v. 69, no. 11, p. 96-98, 100, illus., 1971.

Giant fields contain more than 80 percent of the world's hydrocarbon reserves and more than 90 percent of the reserves in these fields occur in sediments deposited in basins which had their major development during post-Permian time, or during the last cycle of sea-floor spreading. Hydrocarbon-bearing basins can be divided into eight types, principally on the basis of location, regional tectonics, and their relation to continental and oceanic crust. Approximately 90 percent of the reserves in giant fields occur in three types of basins. — WBC

00990 **Klovan, J. E.; Imbrie, J.** An algorithm and FORTRAN IV program for large-scale Q-mode factor analysis and calculation of factor scores: Jour. Internat. Assoc. Math. Geology, v. 3, no. 1, p. 61-77, 1971.

An algorithm and FORTRAN-IV computer program, CABFAC, for Q-mode factor analysis is described [for application to geologic problems]. The program will acept up to 1500 items and 50 variables on a moderate-size computer. — Authors' abstract

Klovan, J. E. *See* Bayliss, P. 08413

08289 **Knutilla, R. L.** Water resources of the River Rouge basin, southeastern Michigan: U.S. Geol. Survey Hydrol. Inv. Atlas HA-356, 2 sheets, maps, diagrams, separate text, 1970.

Koch, J. *See* Jacob, H. 08260

Koide, Minoru. *See* Weiss, Herbert V. 00924

00741 **Kolpack, Ronald L.** (editor). Physical, chemical, and geological studies, V. 2 *of* Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970: [Los Angeles, Calif.], Univ. Southern California, Allan Hancock Found., 477 p., illus., tables, 1971.

The sequence of events which influenced Santa Barbara channel after mid-January, 1969, occurred in a dynamic system. Part of the oil from an offshore-well blowout spread over large areas and was deposited on some beaches and at the sediment-water interface. A major flood occurred at the same time, and large quantities of detrital material were introduced into the channel. This report of the study is divided into 10 chapters, four of which are cited separately, and includes nine appendices covering location maps, summaries of beach and longshore drift measurements, hydrocarbon concentrations, beach, nearshore, and offshore foraminiferal values, and nearshore and offshore sample station locations. — ESL

Kolpack, Ronald L. *See* Drake, David E. 00742

00790 **Kolpack, Ronald L.** Physical characteristics of sandy beaches in the Santa Barbara Channel area, Chap. 2 *in* Physical, chemical and geological studies, V. 2 *of* Biological and oceanographical survey of the Santa Barbara Channel oil spill, 1969-1970: [Los Angeles, Calif.], Univ. Southern California, Allan Hancock Found., p. 7-63, illus., table, 1971.

Ten mainland beaches were selected for monthly study, selection was based on representative geographic spacing as well as variety of environments. The largest flood in 40 years contributed abnormally large quantities of detrital material to the beach environment early in 1969; and oil from a major spill in the channel was deposited on some beaches at a time when the foreshore areas were cut back. Prograding sand buried oil not removed by man, and it remained buried until about Nov. 1969. The normal transgressive-regressive cycle was altered by an overabundance of sand, but by the end of the year was back to normal. Oil deposition on the beaches did not significantly alter normal movement of beach sand. Tar globules removed from the foreshore area, accumulated in troughs just inshore of the breaker line, where they were broken down and transported offshore. — ESL

08277 **Konda, Tadashi.** Pyroxenes from the Beaver Bay gabbro complex of Minnesota: Contr. Mineralogy and Petrology, v. 29, no. 4, p. 338-344, illus., tables, 1970.

Although the Beaver Bay ferrogabbro is a small-scale layered intrusion, Ca-rich pyroxenes show a strong Fe enrichment during fractionation, ranging from augite to ferrohedenbergite. Ca-poor pyroxenes from intermediate pigeonite to ferriferous pigeonite occur as intercumulus minerals. The pyroxenes from the non-layered Beaver River gabbro are included in the overall pyroxene fractionation trend of the Beaver Bay gabbro complex. The pyroxene trend of the gabbro complex is similar to those of the Skaergaard and Bushveld; however, there is a slight difference in that the Ca-rich pyroxenes of Beaver Bay (Mg content over 30 percent) are slightly richer in Ca than in either the Skaergaard or Bushveld augites. — *from* Author's abstract

Korchunov, S. S. *See* Solopov, S. G. 08256

08246 **Korpijaakko, E. O.; Radforth, N. W.** Development of certain patterned ground in muskeg as interpreted from aerial photographs [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 69-73, illus., 1970.

The development of the marbloid airform pattern along a transect from northern Ellesmere Island to central Manitoba was studied by aerial photointerpretation. The pattern shows a development sequence which starts in the Canadian Arctic and proceeds through intermediate stages to the typical marbloid of northern Manitoba. Southward, the pattern is gradually obscured by stronger vegetal growth of muskeg and disappears near the southern limit of permafrost. Development of the pattern in the far north is strongly affected by patterns of underlying mineral terrane which transgress into the peat and are retained in it near the southern limit of the pattern. Such factors enable marbloid to be used as an indicator in predicting certain condi-

tions of mineral terrane. Knowledge of the development sequence in given areas and of other airform patterns such as dermatoid, reticuloid, stipploid, and terrazzoid, helps in revealing the history of environments and in predicting future development of terrane conditions in those areas. — *from* Authors' abstract

Koshelev, B. A. *See* Yemel'yanov, Ye. M. 00835

00780 **Koster, F.** Geological investigations in the Tazin Lake region, northwest Saskatchewan, Canada: Koninkl. Nederlands Akad. Wetensch. Proc., ser. B, v. 74, no. 1, p. 63-84 (pt. 1) and 85-92 (pt. 2), illus., tables, 1971.

The investigated area is located in the Hudsonian orogen (about 1,800 m.y.). Three major map-units display differences with respect to lithology, metamorphic grade, and metamorphic and structural history. Two of these are comparatively stable complexes, in part formed by late-tectonic granites of Hudsonian and Kenoran (about 2,370 m.y.) age. The third major map-unit, a complex of meta-sedimentary to gneissic and migmatitic rocks, occurs between and partly around the former two complexes. The apparent age of the oldest granites and orogen is Kenoran; the granites are remobilized. The surrounding gneisses, which were already folded before emplacement of the granites, are considered to be of Archaean age. — *from* Author's abstract

00730 **Kovach, Robert L.** Earthquake prediction and modification, Chap. 23 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 326-331, illus., 1971.

Earthquakes are among the most destructive of natural phenomena, and statistics reveal that they take an average of 14,000 lives annually. Because of the damaging earthquakes they have suffered, the United States, Japan, and the Soviet Union have intensified their research. Earthquakes cannot be predicted with certainty because the mechanism that produces them is not fully comprehended. Physical changes prior to an earthquake may be useful prediction tools. Man-made earthquakes have occurred as a result of the accumulation of water behind large dams, or waste fluids in a disposal well. Possibilities of earthquake modification and control should be seriously considered. — ESL

08140 **Kretz, Ralph.** Variation in the composition of muscovite and albite in a pegmatite dike near Yellowknife: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1219-1235, illus., tables, 1970.

Regular and irregular variations were found in the concentration of elements in muscovite and albite in relation to the distance from margin to center of a pegmatite dike near Yellowknife. For example, the magnesium content of muscovite increases towards the center, iron decreases, and lithium varies irregularly. The distribution of sodium and potassium among muscovite, albite, and potassium feldspar is considered in relation to mineral reactions and phase equilibrium. Comparison with experimental data indicates that the pegmatite specimens attained near-equilibrium at approximately 450°C. — Author's abstract

Krogh, T. E. *See* Hart, S. R. 08270

Krupicka, J. *See* Burwash, R. A. 08143

00657 **Kudo, Akira; Gloyna, Earnest F.** Transport of Cs-137 — [Pt.] 2, Interaction with bed sediments: Water Research, v. 5, no. 2, p. 71-79, illus., tables, 1971.

The purpose of this study was to describe the transport of Cs-137 in an aqueous environment. The interaction phenomena, i.e., uptake and release of Cs-137 by sediments, were observed by using a set of flumes each 17 m in length and a model river which was 61 m long. The greatest uptake rate, *Kst*, by bed sediment was 88.7×10^{-4}. [(cpm cm^{-2})/(cpm cm^{-3})]/sec . with a velocity of 0.504 m sec^{-1} (1.65 ft sec^{-1}) and a flow rate of 38.2 l sec^{-1} m^{-1} (0.410 cfs ft^{-1}). In this case the sediment transport rate

was 117.5 g sec^{-1} m^{-1} (0.0795 lb sec ft^{-1}). The uptake rate increased as the mean velocity in the channel increased. The desorption rate of Cs-137 was low, being less than 1 percent per month for a mean flow velocity of 3.0 cm sec^{-1}. This rate was obtained in a fresh water system where the concentration of total dissolved solids was about 600 mg l^{-1}. — Authors' abstract

08401 **Kummel, Bernhard.** History of the Earth — An introduction to historical geology, 2d edition: San Francisco, Calif., W. H. Freeman and Company, 707 p., illus., tables, 1970.

The second edition of this textbook, designed for both beginning and advanced students of geology, includes many minor changes in the text, many new illustrations and maps, and many new or completely rewritten sections. Following an introductory chapter, 14 chapters discuss: fossil record, record of sedimentary rocks, Precambrian eras, Paleozoic Era and life, Mesozoic Era and life, Gondwana formations, Cenozoic Era and life, and Pleistocene epoch. Appendixes include an introduction to animals and plants, and correlation charts for the Cambrian through the Cenozoic both in and outside of North America. — VSN

08174 **Kupsch, W. O.** John Compbell Sproule, 1905-1970: Royal Soc. Canada Minutes Proc. 1970, ser. 4, v. 8, p. 137-141, portrait, 1970.

Lagache, Martine. *See* Martin, Robert-F. 08375

00616 **Lahr, John C.; Wyss, Max; Hileman, James A.** Repeated surveys of small scale figures established across surface fault ruptures following the earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 86-88, table, 1971.

Starting 36 hours after the San Fernando earthquake, four small-scale geodetic figures were established across the zone of surface-fault ruptures. Each figure consists of one or two theodolite stations and about three reference points on each side of the fault. Two of the figures indicate no more than 2 mm of displacement. The data at the Middle Ranch figure, which spans the fault at the mouth of Little Tujunga Canyon, show that a small additional thrust with 2 mm uplift and 6 mm of compression may have occurred between two and four days after the main event. Displacements at the Aztec figure in Sylmar are consistent with left-lateral shear in the zone of the figure and range from 4 to 20 mm. — *from* Authors' abstract

Lamb, George M. *See* Isphording, Wayne C. 00885

Langway, C. C., Jr. *See* Dansgaard, W. 08209

Langway, C. C., Jr. *See* McCorkell, R. H. 08210

Langway, C. C., Jr. *See* McCorkell, R. H. 08214

08208 **Langway, Chester C., Jr.** Features and measurements of deep polar ice cores obtained by various drilling methods [abs.], *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hyrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 77, 1970.

00913 **Lapham, D. M.** Elmer B. Rowley — Teacher, collector, and mineralogist: Mineralog. Record, v. 2, no. 1, p. 9, 15-16, portrait, 1971.

Lapraz, D. *See* Keller, P. 00675

Laurin, A. F. *See* Wynne-Edwards, H. R. 08121

Leake, Bernard E. *See* Kalsbeek, Feiko. 08355

08346 **Leavens, Peter B.; White, John S., Jr.; Hey, Max H.** Eakerite — A new tin silicate: Mineralog. Rec., v. 1, no. 3, p. 92-96, illus., tables, 1970.

Eakerite, $Ca_2SnAl_2Si_4O_{16}(OH)_2$, is found at the Foote Mineral Company spodumene mine, Kings Mountain, North Carolina. It occurs in colorless, prismatic crystals up to 5 mm long in seams with quartz, albite, bavenite, and apatite in spodumene-rich pegmatite. It is monoclinic (cell dimensions and strongest X-ray lines given), and the crystals somewhat resemble those of laumontite in habit. Eakerite is colorless; hardness about 5 1/2; gravity about 2.93; optically biaxial, positive, $n\alpha = 1.584$, $n\beta = 1.586$, $n\gamma = 1.600$ (Na light) with 2V about 35°. Analysis gave $SiO_2 = 46.75$, $Al_2O_3 = 14.07$. $SnO_2 = 18.59$, $CaO = 14.2$, and $H_2O = 6.7$ percent. Thermogravimetric analysis indicates that the water is held as hydroxyl. — *from* Authors' abstract

00991 **Leblanc, Rufus Joseph, Jr.** Environments of deposition of the Yegua Formation (Eocene), Brazos County, Texas: Corpus Christi Geol. Soc. Bull., v. 11, no. 6, p. i-v, 1-70, illus., tables, 1971.

Results of analyses of a basal outcrop and 10 shallow cores across the outcrop width of the Yegua Formation around Bryan and College Station, Texas, were combined with subsurface data. The surface outcrop of the formation in the study area was deposited in various complexes of a lower deltaic plain region. Environments represented are deltaic fringe, distributary mouth-bar, point-bar marsh, lake, and bay as interpreted from qualitative and quantitative criteria. Two sets of deltaic wedges consisting of progradational, aggradational and transgressive facies can be detected in the outcrop and extend into the subsurface for at least 20 mi downdip from it. The Yegua Formation is divided into two members, based on a combined sequence of physical characteristics and reflecting the depositional environments. — *from* Author's abstract

Lee, Keenan. *See* Lyon, R. J. P. 08231

00817 **Lee, Kenneth L.; Strauss, Michael E.** Prediction of horizontal movements due to subsidence over mined areas [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 512-522, illus. [1971].

Some interrelations between vertical and horizontal movements in ground subsidence problems are summarized. A case history of horizontal movements which develop as a result of subsidence over a sulphur mining area is discussed. The finite element method of analysis is shown to give a good prediction of the correct nature and magnitude of both vertical and horizontal movements resulting from this mining subsidence problem. — Authors' abstract

Lee, W. H. K. *See* Wesson, R. L. 00609

Leonardsen, Erik S. *See* Sorensen, Henning. 08293

00750 **LePichon, Xavier; Eittreim, S.; Ewing, John I.** A sedimentary channel along Gibbs fracture zone: Jour. Geophys. Research, v. 76, no. 12, p. 2891-2896, illus., 1971.

The depositional asymmetry associated with a channel along the fracture zone at 52° N. in the Atlantic is explained by an eastward-flowing bottom current. This current, below 3000 m, is opposite to the known westward flow of the overlying Scotland-Iceland overflow water. This eastward flow is significant in distribution of bottom sediments and may explain the temperature and salinity similarity of the European basin bottom water to North Atlantic deep water of the western basin. — Authors' abstract

08273 **Lerman, Abraham; Weiler, Roland R.** Diffusion and accumulation of chloride and sodium in Lake Ontario sediment: Earth and Planetary Sci. Letters, v. 10, no. 1, p. 150-156, illus., tables, 1970.

Distribution of Na^+ and Cl^- in the upper 30 cm of Lake Ontario sediment cores indicates that the two species are being transferred from the lake water into the sediments, owing probably to a strong increase in their concentrations during the 20th Century. The total amount of each species which has entered and accumulated in the sediment-pore water column since the concentrations in the lake began to rise is, for Cl^-, 2.96 mg cm^{-2} and, for Na^+, 1.31 mg cm^{-2}. The amounts accumulated in the sediment are on the order of only 1-2 percent of the amounts of the two species now present in the lake water. — *from* Authors' abstract

08418 **LeRoux, J.; Rich, C. I.; Ribbe, P. H.** Ion selectivity by weathered micas as determined by electron microprobe analysis [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 18, no. 6, p. 333-338, illus., table, 1970.

Electron-probe micro-analysis studies on individual particles (40-60 mesh) of weathered micas treated with solutions containing equivalent amounts of Rb and Sr showed partial segregation of these elements. Rb was concentrated at particle and step edges, at cracks, and, in partially K-depleted biotite, at boundaries of vermiculite and mica zones ("wedge zones"). The scarcity of wedge zones in mica from which nearly all of the K had been removed reduced the overall selectivity for Rb. The restricted exchange of interlayer Mg ions from vermiculite-like zones by a mixed Rb-Sr solution was observed in earlier studies. The proposed explanation for these results was a closing down of interlayer space at the particle edge due to Rb concentration in these positions. This explanation is confirmed by the present study. — *from* Authors' abstract

00773 **Levchenko, V. A.; Echevarría, G.** Novyye neftyanyye mestorozhdeniya Kuby [New oil fields of Cuba]: Geologiya Nefti i Gaza, no. 1, p. 53-58, illus., 1971.

Between 1966 and 1969 several new oil fields were found in Upper and Lower Cretaceous and Upper Jurassic deposits in central Cuba. The Cristales del Sur field is located in the southeastern margin of the central depression which is a transverse graben and eugeosyncline filled with Tertiary and Upper Cretaceous sedimentary deposits above Cretaceous volcanic and sedimentary strata. The Guanabo, Villa Blanca and Jaruco fields, located on the north coast of Cuba, 25-40 km east of Havana in an area where the Cuban meganticlinorium joins the marginal trough of the Bahama platform, were recently discovered during seismic exploration along a NW-trending fault which extends into the sea. Exploration is continuing in this region and in the Mariel area west of Havana. Tectonic regions of central Cuba are outlined and mapped. — EH

00984 **Levi-Donati, G. R.; Jarosewich, Eugene.** The Valdinizza meteorite — Mineralogy, chemistry and microtextures: Meteoritics, v. 6, no. 1, p. 1-14, illus., 1971.

The principal data are collected about the fall and the distribution of the fragments of the Valdinizza, Italy, meteorite. A complete individual, weighing 872 g, preserved in the United States National Museum, Washington, D.C., is described in some detail. The mineralogical composition is olivine, Fa_{25}; hypersthene, Fs_{23}; plagioclase, An_{10}; maskelynite; nickel-iron; troilite; chromite; ilmenite and possibly a phosphate mineral. Valdinizza is a farily typical hypersthene chondrite, belonging to the type 6 chondrites of Van Schmus and Wood (1967); its structure shows evidence of a period of high-temperature recrystallization; interesting features of shock-metamorphism are notable, the microtexture deformations suggesting a high level of stress. — Authors' abstract

Levinson, A. A. *See* Bayliss, P. 08413

08280 **Lewis, Clyde L.; Ott, Welland L.** Analytical chemistry of nickel: Elmsford, N. Y., and Oxford, England, Pergamon Press, 233 p., illus., tables, 1970.

This book gives instructions for the determination of nickel in any material in which it may be found. The remarkable number and variety of materials which are analyzed for nickel have been classified broadly as: *metals and alloys*, *non-metallic materials*, and *organic materials*. A major analytical method is treated in each of chapters 6 to 15, and techniques for as many of these sample types as may be applicable are described. The introductory chapter includes recommendations as to the optimum method for each type; the next four chapters deal with: preparation of samples for analysis, qualitative and semi-quantitative determination of nickel, and its separation and isolation. — GDC

00933 **Lewis, Richard Q., Sr.** The Monteagle Limestone of south-central Kentucky: U.S. Geol. Survey Bull. 1324-E, 10 p., illus., 1971.

Geologic mapping and stratigraphic studies show that nomenclature for rocks of Late Mississippian age in Alabama and Tennessee is generally applicable in south-central Kentucky and that the Monteagle Limestone of Late Mississippian age is divisible into two mappable members. These are, in ascending order, the Ste. Genevieve Limestone Member and the Kidder Limestone Member (new name). — Author's abstract

Leyden, D. E. *See* Blount, C. W. 00909

00769 **Liberty, B. A.; Bolton, T. E.** Bruce Peninsula area, Ontario: Canada Geol. Survey Map 1194A, scale 1:253,440, 1969; also in Canada Geol. Survey Mem. 360, 1971.

00770 **Liberty, B. A.; Bolton, T. E.** Paleozoic geology of the Bruce Peninsula area, Ontario [with French, German, and Russian abs.]: Canada Geol. Survey Mem. 360, 163 p., illus., tables, geol. map, 1971.

The report describes flat-lying Paleozoic carbonate strata on the east flank of the Michigan Basin. Map units and stratigraphic nomenclature used are consistent with those in adjacent areas to the south and east, and can be used on Manitoulin Island. Several southern Ontario stratigraphic problems have been resolved by: adoption of the term Dundee in preference to Norfolk and Delaware; definition of the biohermal facies within the Detroit River Fm.; establishment of the relation of the Detroit River to the Bois Blanc and Onondaga; and recognition of the importance of the Rocky Bay section, near Cabot Head, to the Lower and Middle Silurian. Production of salt and natural gas from the Goderich area, and facing-stone from the Wiarton area, are the only economic operations. [Three appendices contain 32 stratigraphic sections, faunal lists, and eight well logs.] — *from* Authors' abstract

00661 **Liebermann, Robert C.; Banerjee, Subir K.** Magnetoelastic interactions in hematite — Implications for geophysics: Jour. Geophys. Research, v. 76, no. 11, p. 2735-2756, illus., tables, 1971.

Domain wall-stress interaction causes pronounced increases in attenuation and decreases in velocities of ultrasonic waves in hematite at 298°K relative to the values in a saturating magnetic field. For compressional modes, these effects may be eliminated by application of a magnetic field of 2 kilogauss in the basal (c) plane. At zero applied field, it was not possible to propagate shear waves in the single crystal; as the field is varied from 2 to 4 kG, the attenuation decreases and velocities increase. These magnetoelastic interactions can be eliminated by cooling through the Morin temperature. Results of this study have important consequences for ultrasonic studies of the elastic properties of third-transition metal oxides, for static compression experiments on these materials, and for studies of phase transitions in solids. — *from* Authors' abstract

Liebermann, Robert C. *See* Wyss, Max. 00663

08144 **Lilley, F. E. M.; Carmichael, C. M.** Electromagnetic damping of elastic waves, a simple theory: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1304-1307, illus., tables, 1970.

An order-of-magnitude estimate is made to check the effect observed in previously described experiments in which vibrations in a metal bar were damped by an applied magnetic field that was strongly non-uniform. Though the awkward geometry of the experiment has prevented an accurate analytical solution of the problem, some reasonable assumptions allow a simple expression for the effect to be obtained directly. This expression is in agreement with the experimental results regarding the dependence of the effect upon frequency, bar dimensions, density, electrical conductivity, and magnetic field gradient. — Authors' abstract

08207 **Linkletter, George O.** The use of cationic ratios in determining annual stratigraphic layers in polar ice [abs.]: *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 16-18, illus., 1970.

Lisitsyn, A. P. *See* Yemel'yanov, Ye. M. 00835

08158 **Little, H. W.** Distribution of types of uranium deposits and favourable environments for uranium exploration, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 35-48, incl. discussion, illus., table, 1970.

Productive uranium deposits in Canada are of four types: conglomeratic; hydrothermal veins and disseminations with simple mineralogy; with complex mineral associations; and pegmatitic. All occur in the Shield, near the edge. Extensions of known deposits and new orebodies adjacent to known ones have been outlined recently, and promising indications of deposits in new districts, some of new types, have been uncovered. New discoveries have confirmed some predictions of favourable environments for certain types of deposits; early Proterozoic pyritiferous conglomerates wherever found are to some extent uraniferous, but those of late Proterozoic age are not. Lignitic uranium deposits being drilled in Oligocene beds are predicted to be favourable. New discoveries have been made in the Shield in areas found to be lithologically and/or structurally favourable. — *from* Author's abstract

Lockwood, John P. *See* Bateman, Paul C. 00648

00808 **Lofgren, Ben E.** Field measurement of aquifer-system compaction, San Joaquin Valley, California, U.S.A. [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 272-284, illus. [1971].

Two types of field measurements have been used to monitor aquifer-system compaction, and accompanying land subsidence in California: periodic releveling of a network of surface bench marks, referenced to distant stable bedrock, and continuous recording of vertical shortening of the water-bearing deposits, using extensometers installed in cased wells. Compacting deposits of the aquifer system are readily compressible and sensitive to change in overburden stress Imposed hydraulic stresses, caused by extracting of fluids, results in immediate strain in the aquifer system. Both elastic compression and inelastic rearrangement of the intergranular structure are caused by a stress increase; however, elastic expansion during stress decrease is small compared to ultimate plastic compaction for a comparable stress increase. The subsidence/stress-change ratio ranges from 0.5 to 10×10^{-2} feet of subsidence per foot of hydraulic stress change during the first prolonged cycle of water-level decline. — *from* Author's abstract

00895 **Lomnitz, C.** What is the accuracy of P travel-time tables,: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 193-195, illus., 1971.

The discussion on accuracy of P traveltimes remains inconclusive, because the variance of raw traveltime data is large in terms of the J-B error. Iteration procedures based on free epicentral parameters and station corrections contain systematic errors when the distribution of azimuths and distances differs greatly from that assumed. Relevant comparisons between different P-times estimates require that (a) epicentral parameters be estimated independently of traveltimes, (b) the true marginal distributions of azimuths and distances be taken into account. — Author's abstract

Long, A. T. *See* Floyd, E. O. 08342

08379 **Looney, Mary.** Washita Bat Caves: Oklahoma Underground, v. 3, no. 2, p. 42-46, illus., 1970.

Washita Bat Caves in the Weatherford-Clinton area of Washita County, Oklahoma, consists of three separate caves which are mapped as one unit. The caves are formed in the Cloud Chief Formation, of Permian age, which consists of several members of gypsum, reddish sandstone and dolomite. Joint control is evident in many places in the caves. — EH

Low, Doris. *See* Todd, Ruth. 00740

Low, Philip. *See* Davidtz, John C. 08392

00940 **Low, Philip F.; White, Joe E.; Ravina, Israela.** Changes in *b* dimension of Na montmorillonite with interlayer swelling: Nature Phys. Sci., v. 230, no. 15, p. 159-160, illus., 1971.

The *b* dimension of six different Na-montmorillonites has been found to increase with swelling in water from an initial value characteristic of each montmorillonite to a final value of about 9.0 A common to all montmorillonites. The water content at maximal swelling was proportional to the total change in *b* dimension. These results support the explanation proposed earlier (1970), that the increase in *b* dimension is the result of strong interaction between montmorillonite and water which modifies their respective structures. — DBV

Lumbers, S. B. *See* Ayres, L. D. 00870

Lumbers, S. B. *See* Ayres, L. D. 00871

Lumbers, S. B. *See* Ayres, L. D. 00872

Lumbers, S. B. *See* Ayres, L. D. 00873

00864 **Lumsden, David N.; Pittman, Edward D.; Buchanan, Richard S.** Sedimentation and petrology of Spiro and Foster sands (Pennsylvanian), McAlester basin, Oklahoma: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 254-266, illus., tables, 1971.

The Foster sand represents local stream channels that cut into Morrowan strata while draining southeastward in the McAlester basin. These streams brought detritus to the southern part of the basin where the Spiro sand was forming in a shore zone that probably included beaches, bars, tidal flats, tidal channels, and lagoons. During a northward transgression the Spiro sand was deposited across the basin and locally overlies the Foster sand. The Foster is fine-grained quartz sandstone with well-rounded, moderately sorted grains. The Spiro is very fine to medium-grained sandstone with subangular to well-rounded, poorly to very well-sorted grains. Analysis of Spiro facies, primarily by isopach maps and grain size, indicates that dry gas production limits have been established, with the possible exception of reservoirs in the Ouachita Mountains. — *from* Authors' abstract

Lunking, W. *See* Horton, J. W. 00736

00722 **Lutton, R. J.** A mechanism for progressive rock mass failure as revealed by loess slumps: Internat. Jour. Rock Mechanics and Mining Sci., v. 8, no. 2, p. 143-151, illus., 1971.

The mechanics of slumping in steep loess cuts appears basic to rock-slope failure, arch formation, subsidence, or tunnel and pillar slabbing. At instant of failure, bounding tensile fractures form shell-like around the weakened zone; simultaneously a second set of curved fractures, orthogonal to the first, develops, dipping out of the slope along one of a family of shear stress planes. Similar features are found in rock. Rock in the back of a tunnel is prone to cave up to a limiting arched surface; rock beyond is metastable until its lateral support or strength deteriorates and the limiting trajectory shifts outward, progressing to ground surface where subsidence takes place. In strong rocks, the limiting surface follows trajectories directly above the sides of excavation; in weak material it diverges up- and outward along shear stress trajectories. — *from* Author's abstract

Luyendyk, Bruce P. *See* Bada, Jeffrey L. 00712

LV A. *See* Hughes, G. M. 00822

Lydon, Phillip A. *See* Bateman, Paul C. 00648

08231 **Lyon, R. J. P.; Lee, Keenan.** Remote sensing in exploration for mineral deposits, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 58-65, illus., tables [1970].

This paper defines data requirements for remote sensing of mineral resources. In the paper the term "remote sensing" is restricted to electromagnetic radiation from ultraviolet through microwave frequencies. The author describes surface manifestations of the targets for remote sensing, the general geology, indicators of ore deposits, hydrocarbons, and ground water, potential geothermal energy sites, and the presence of permafrost. Definition of these surface phenomena is the requirement for effective use of sensors. Photographic film is and will still be the prime sensor since earth scientists prefer imaged to non-imaged data. The need for geologists to have sensor training is emphasized. — EH

MacDiarmid, Roy A. *See* Park, Charles F., Jr. 08398

MacDonald, R. B. *See* Atwell, B. Houston. 00948

MacDonald, Raymond. *See* Upton, Brian G. J. 00856

08218 **Macdonald, Raymond; Edge, R. A.** Trace element distribution in alkaline dykes from the Tugtutôq region, South Greenland: Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 38-58, illus., tables, 1970.

The intermediate to acid alkaline dikes of the Tugtutôq area, South Greenland, are characterized by high concentrations of Li, Rb, Y, La, Ce, Nb, and Pb, and by intense depletion in Sr, Ba, and Cr. The distribution of the trace elements is consistent with the theory that the dikes evolved by fractional crystallization, though part of the original Cl, H_2O, Li, and Ga contents of the rhyolitic magmas was lost on devitrification of the dikes. — Authors' abstract

08219 **Macdonald, Raymond; Parker, A.** Zirconium in alkaline dykes from the Tugtutôq region, South Greenland: Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 59-63, illus., table, 1970.

Zr values are reported for 30 alkaline dikes from the Tugtutôq area, South Greenland. Concentrations increase in the fractionation series trachydolerite — aegirine microgranite to a maximum of 7,175 ppm, but it is not yet clear how Zr is distributed between the various minerals in the silicic dikes. — Authors' abstract

08220 **Macdonald, Raymond.** Mid-Gardar feldspathoidal dykes in the Tugtutôq region, South Greenland: Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 64-66, tables, 1970.

Analyses and modes of feldspathoidal dikes from the Tugtutôq area, South Greenland, are included in tables. These dikes are the only recorded examples of undersaturated syenitic rocks intruded in the area after the consolidation of the giant gabbro dikes. — EH

08248 **MacFarlane, I. C.; Radforth, N. W.** Structure as a basis of peat classification [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 91-97, illus., tables, 1970.

Methods existing for identifying and classifying peat qualitatively on a structural basis are inadequate when quantitative expression of structure is attempted. This imposes a limitation on geotechnical analysis and comparison of peat type. A concept is developed whereby macro- and microstructure of peat are accounted for in terms that are consistent with its behavior. Structure is understood as the morphology and arrangement of constituent organic elements in peat, both in macro and micro aspects. A single homogeneous non-woody, fine-fibrous peat type is analyzed to test the concept. It is concluded that structure of peat presents a natural basis for quantitative classification of the material, in both dry and wet states. The complexity of peat in situ can be reduced to relatively few gross structural types; a macro- and microscopic examination of these should result in development of a mathematical model for each type, and should represent adequately the natural condition. — *from* Authors' abstract

08254 **MacFarlane, I. C.** Strength and deformation tests on frozen peat [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 143-149, illus., tables, 1970.

Axial compression tests were carried out on frozen fibrous peat samples to test the hypothesis that peat in its frozen state exhibits rheological properties similar to those of frozen inorganic soils. Curves plotted from test results indicate that a load applied to a frozen peat sample will cause it to react in a time-dependent manner, as for inorganic soils. A series of unconfined compression tests shows that the strength of frozen peat is quite high. Strength varies with temperature; the lower the temperature, the higher the strength. Rate of load application affects strength, with a higher strain rate resulting in higher strength. Highest strengths and lowest strains occur in samples tested parallel to the natural bedding plane of the peat. Test results represent values of 350 to 400 times the unconfined compressive strength of unfrozen peat. — *from* Author's abstract

00949 **Machemehl, Jerry L.** Sediment transport in flow disturbed by rainfall: Water Resources Bull., v. 7, no. 2, p. 317-329, illus., tables, 1971.

Studies were conducted in a closed system recirculating research flume to evaluate the relative effects of high intensity rainfall on von Karman's universal constant and the sediment transport capacity of shallow flow. Techniques are described. Regression analyses on velocity data determined the best fit dimensionless velocity curve. Von Karman's universal constant was then evaluated from the slope of regression line. Point sediment samples were siphoned from the flow and concentrations were found; samples were taken with and without rainfall to evaluate relative effect of rainfall on transport capacity. Results indicate that suspended sediment reduces the value of von Karman's constant, and owing to this reduction, suspended load transport capacity of flow is reduced under simulated rainfall. — VSN

00641 **Macintyre, R. M.** Apparent periodicity of carbonatite emplacement in Canada: Nature Phys. Sci., v. 230, no. 12, p. 79-81, tables, 1971.

Carbonatites in Canada seem to have been intruded at intervals of 233 m.y. for at least the last 1,700 m.y., and these may have been particularly favorable times for the emplacement of carbonatites elsewhere. There are exceptions, but it is interesting that the apparent period resembles the galactic day (245 m.y., ± 10 percent); a fundamental connection between cosmic and terrestrial phenomena may be implied. — DBV

00685 **MacKevett, E. M., Jr.; Brew, David A.; Hawley, C. C.; Huff, Lyman C.; Smith, James G.** Mineral resources of Glacier Bay National Monument, Alaska: U.S. Geol. Survey Prof. Paper 632, illus., tables, geol. map, 1971.

Results of an investigation of the mineral-resource potential of Glacier Bay National Monument are summarized. Metals of potential economic importance are Cu, Mb, Ni, Au, Ag, Ti, and Fe; Tertiary sedimentary rocks bordering the Gulf of Alaska may be hosts for petroleum, but the potential is low. New mineral deposits discovered include copper-molybdenum in Bruce Hills; veins and altered zones north of White Glacier; base-metal lodes near Mount Brack; and copper deposits south of Rendu Glacier, near Gable Mtn., east of Dundas Bay, and west of Tarr Inlet. Previously known deposits are described in order of economic potential; the Nunatak molybdenum and Brady Glacier nickel-copper prospects are most likely to be developed soon. Newly found deposits probably will not be of major importance because of remoteness and difficulties of access. Most deposits east of the Fairweather Range probably have been found. — VSN

00935 **MacKevett, E. M., Jr.** Stratigraphy and general geology of the McCarthy C-5 quadrangle, Alaska: U.S. Geol. Survey Bull. 1323, 35 p., illus., table, 1971.

This 15-min quadrangle includes a rugged area on the southern flank of the Wrangell Mts. having relief of about 12,000 feet. The quadrangle contains a sequence of consolidated layered rocks, about 25,000 feet thick, local intrusive rocks, and widely dis-

tributed surficial deposits. Layered rocks are chiefly Mesozoic but range from Permian to Quaternary in age, and include two sequences of subaerial volcanic rocks, abundant shelf deposits, and continental sedimentary rocks. Intrusive rocks are mainly Tertiary dikes and sills of dacitic or andesitic composition with a few small stocks of granodiorite. Surficial deposits are largely related to glacial processes. The main faults and folds formed during a major orogeny at or near the close of the Jurassic or in pre-Albian Cretaceous. The quadrangle contains the main Kennecott mines of Alaska, for years among the world's foremost copper producers. — *from* Author's abstract

MacLean, Brian. *See* King, Lewis H. 08126

08145 **Macqueen, R. W.; Ghent, E. D.** Electron microprobe study of magnesium distribution in some Mississippian echinoderm limestones from western Canada: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1308-1316, illus., table, 1970.

Four samples from the Loomis Member of the Mt. Head Formation show highly variable Mg content in echinoderm grains, whereas sparry calcite cement and oöids are relatively uniform. One sample from the Livingston Formation shows the same, whereas another sample from the Livingstone has similar variation but a much smaller mean for the echinoderm grains. All the echinoderm grains analyzed show abundant dolomite crystals 1 to 6μ in diameter which appear to account for the variable values of the Mg distribution, but are not obviously related to the original stroma canal structure. Sparry cement and oöid rings are free of dolomite crystals. The dolomite crystals are interpreted as late-stage exsolution products of small residual amounts of Mg from both the original grains and their pore-filling calcite. — HRC

00633 **Maley, R. P.; Cloud, W. K.** Preliminary strong-motion results from the San Fernando earthquake of February 9, 1971, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 163-176, illus., tables, 1971.

More than 250 accelerograph records and 100 seismoscope records on the San Fernando earthquake have been obtained from the network of instruments in southern California. Maximum ground accelerations were observed at Castaic and Lake Hughes where values were slightly less than 0.4 g, and at Pacoima Dam where a few peaks were in the 1-g range, the highest ever recorded. These records represent the largest collection of significant strong-motion data ever obtained, and should be of unprecedented value to all engineers and scientists concerned with problems of seismic hazards. — VSN

08134 **Mamet, Bernard L.** Sur les *Umbellaceae* [On the *Umbellaceae* (with English abs.)]: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1164-1171, illus., 1970.

The presence of an apical lid is recognized among Devonian Umbellids of Alberta. Their attribution to the Paleozoic foraminifers is therefore unwarranted and their transfer to the charophytes is suggested. The taxonomy of the family is revised and three new genera are proposed. — Author's abstract

Mammerickx, J. *See* Chase, T. E. 08323

Manchester, K. S. *See* Grant, A. C. 08164

Mancuso, J. J. *See* Den Besten, I. E. 08268

00914 **Mandarino, J. A.** Memorial to Dr. V. B. Meen: Mineralog. Record, v. 2, no. 1, p. 9, portrait, 1971.

Mark, D. M. *See* Roberts, M. C. 08136

Marshall, Lauriston C. *See* Berkner, Lloyd V. 00775

00874 **Marshall, Monte; Cox, Allan.** Magnetism of pillow basalts and their petrology: Geol. Soc. America Bull., v. 82, no. 3, p. 537-552, illus., table, 1971.

The average intensity of magnetization of a layer of pillow basalt depends on (1) variations in the intensity of the Earth's field as the lava is formed, (2) variations in the direction of magnetization within the layer, (3) the percent of nonmagnetic pore space between pillows, and (4) variations in the thermoremanence of the basalt due to variations in composition and in the degree of crystallization. The main control on remanence is the degree of crystallization. The magnetization of the basalts resides in titanomagnetite grains. The variation of natural remanence with grain size in the range 3 to 6 microns suggests pseudo-single domain behavior. Our best estimate of the average magnetization of a layer of submarine pillow basalt is .014 emu/cc. A layer less than 1 km thick with a value of remanence this high is adequate to account for most marine magnetic anomalies. — *from* Authors' abstract

Marshall, R. *See* Coker, A. E. 08410

08375 **Martin, Robert-F.; Lagache, Martine.** L'effet du remplacement du potassium par le rubidium sur les paramètres de la maille de la sanidine et la leucite (The effect of replacement of potassium by rubidium on the lattice parameters of sanidine and leucite): Soc. Francaise Minéralogie et Crystallographie Bull. 93, nos. 5-6, p. 581-582, tables, 1970.

A study of trace elements lead to synthesis of sanidine and leucite in which potassium is partially replaced by rubidium. Measurements were made on five specimens of each at 600°C and 800 bars pressure in the presence of a solution of potassium and rubidium chlorides. The amount of molar substitution never exceeded 10 percent. — ESL

Martin, T. G. *See* Murrmann, R. P. 08191

00727 **Mason, Brian.** Meteorites, Chap. 8 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 114-121, illus., tables, 1971.

The composition and structure of meteorites provide some of the most direct evidence concerning evolution of the planets. Phenomena of falls are described, and meteorite classification based on mineralogy and structure is tabulated. About 60 minerals are known from meteorites, but many are rare accessories. Over 80 percent of meteorite falls are chondrites; they show a remarkable homogeneity in chemical composition. It is now clear that asteroids are not fragments of a disrupted planet, but represent solid material that failed to aggregate. Some speculations on the temperature and size of meteorite parent bodies are given. Because the identification of tektites as meteorites is disputed, they are not included. — ESL

Matthews, J. V. *See* Hopkins, D. M. 00695

08266 **Maynes, A. D.** A new procedure for the determination of metallic iron in chondritic meteorites: Chem. Geology, v. 6, no. 4, p. 255-263, tables, 1970.

Metallic iron in stony meteorites is dissolved with 50 ml of a solution containing 1 g of ferric chloride hexahydrate, 1 g of ammonium sulphate and 0.1 g ferrous ammonium sulphate at pH 2.05, and the amount determined by titration of the ferrous iron with standard dichromate solution. A correction must be made for the nickel and cobalt present. Troilite and other non-magnetic minerals do not interfere. A small amount of high-nickel taenite is not dissolved, and the results for metallic iron will be slightly low. — Author's summary

00806 **Mayuga, M. N.; Allen, D. R.** Subsidence in the Wilmington oil field, Long Beach, California, U.S.A. [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 66-79, illus. [1971].

The subsidence area is in the shape of an elliptical bowl superimposed on top of California's largest oil giant, the Wilmington oil field. he center of the bowl has subsided over 9 m (29 feet) since 1926. Horizontal and vertical movements have caused extensive damage necessitating costly repairs and remedial work, including the raising of land surface areas to prevent inundation by the sea. Most investigators agree that withdrawal of fluids and gas and consequent reduction of subsurface pressures in the reservoirs caused compaction in oil zones. A massive repressurization program, by injection of salt water into the oil reservoirs, has reduced the subsidence area from approximately 50 sq km to 8 sq km. The rate of subsidence at the historic center of the bowl has been reduced from a maximum of 75 cm (28 inches) per year in 1952 to 0.0 cm (0.0 inch) in 1968. A small surface rebound has occurred in areas of heaviest water injection. — *from* Authors' abstract

Mayuga, M. N. *See* Allen, D. R. 00814

00760 **McBirney, A. R.; Murase, T.** Factors governing the formation of pyroclastic rocks: Bull. Volcanol., v. 34, no. 2, p. 372-384, illus., 1971.

The basic condition governing the formation of pyroclastic rocks is the relationship between the disruptive force of gas pressure in bubbles to the strength of the liquid for short term stresses and surface tension. The latter factor controls the coalescence of bubbles, because it is strongly dependent on the composition, temperature, and water content of the liquid. Data on surface tension of volcanic liquids are presented. — Authors' abstract

08214 **McCorkell, R. H.; Pinson, W. H.; Fireman, E. L.; Langway, C. C., Jr.** A search for cosmic dust in a large collection of particulate and dissolved material from polar ice, *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 25-30, tables, 1970.

Large collections of dissolved and particulate material from the ice at Camp Century, Greenland, were made and studied in the hope that evidence of cosmic dust would be found. Results described are of interest, but throw little light on the questions of the nature and influx rate of cosmic dust. Tables give concentrations of ions in water from ice, composition of particulate material from ice, comparison of composition of inorganic material in ice with average crustal material, radioisotopes found in Camp Century ice, and calculated and measured Al-26 precipitation rates. — GDC

00883 **McCoy, Roger M.** Rapid measurement of drainage density: Geol. Soc. America Bull., v. 82, no. 3, p. 757-761, illus., table, 1971.

Investigations were made of three methods for rapid measurement of drainage density using topographic maps and radar imagery. (1) Measurement of blue line stream symbols proves feasible but yields inconsistent results. (2) The number of intersections of streams on a random line pattern overlying a map provides a good estimate of drainage density. (3) Edge-enhancement of radar images produces a measurable line pattern which appears to be strongly related to total length of streams in a basin. — Author's abstract

00878 **McDonald, B. C.; Shilts, W. W.** Quaternary stratigraphy and events in southeastern Quebec: Geol. Soc. America Bull., v. 82, no. 3, p. 683-697, illus., tables, 1971.

The Appalachian region of southeastern Quebec has experienced four glacial phases, the last three of which are represented by tills of Wisconsin age, named the Johnville, Chaudière, and Lennoxville. Stratified intertill sediments record significant nonglacial intervals. Johnville ice flowed from the northwest; Chaudière ice first from the northeast and later from the northwest; Lennoxville ice flowed from the northwest. The interglacial intervals are correlated with stratigraphic units in neighboring areas. The Quebec Appalachians were deglaciated by about 12,500 C-14 yrs B.P. — *from* Authors' abstract

00828 **McDowell, S. D.; Wyllie, P. J.** Experimental studies of igneous rock series — The Kungnat syenite complex of southwest Greenland: Jour. Geology, v. 79, no. 2, p. 173-194, illus., tables, 1971.

Melting relations of five rocks from the alkaline igneous complex at Kungnat, southwest Greenland, were determined in the presence of 25 wt percent water at pressures to 3 kbar. Samples are from the two layered syenite bodies comprising the complex and from late granite sheets intruding the syenites. Results are consistent with the hypothesis that there were four magma portions tapped from an already differentiated magma chamber, with each subsequently differentiating along independent paths after emplacement. Magmas were emplaced at low water pressures at about 1,000°C. Phase relations in syenites differ from those previously reported for calc-alkaline plutonic series from tonalite to granite by the wide temperature interval for crystallization of two feldspars and the absence of amphibole through the melting interval because of low dissociation temperature of amphibole. — *from* Authors' abstract

00676 **McKague, H. Lawrence.** The refractometer in mineralogy instruction: Jour. Geol. Education, v. 19, no. 2, p. 67-72, illus., table, 1971.

The refractometer can be used at many levels of instruction because of its speed and simplicity. In an introductory mineralogy course, it can be used to introduce optical theory as well as to determine optical properties of minerals. In advanced courses, it can be used to demonstrate optical theory. The optic nature (isotropic or anisotropic), highest and lowest indices of refraction within the range of the refractometer, and birefringence can always be resolved. With polished surfaces oriented with respect to the optical directions in the mineral, it can be determined if the mineral is uniaxial or biaxial and positive or negative. — Author's abstract

McKee, E. H. *See* Miller, F. K. 00881

00962 **McKee, Edwin H.; Stewart, John H.** Stratigraphy and potassium-argon ages of some Tertiary tuffs from Lander and Churchill Counties, central Nevada: U.S. Geol. Survey Bull. 1311-B, 28 p., illus., tables, geol. map, 1971.

Welded tuffs from 21 to 31 m.y. old, make up most of the Desatoya Mts., New Pass Range, and the central Shoshone Mts. In the northern part of this area, 13 ash-flow-tuff cooling units are recognized; five constitute the newly named Edwards Creek Tuff, the most widespread formation in the area, with a K-Ar age of about 27 m.y. The Bates Mtn. Tuff (about 24 m.y.) is composed of three cooling units and forms the upper part of the section. Volcanic rock in the Desatoya Mts. consists of six welded tuffs, only one of which is identified in other areas, a distinctive biotite-bearing rock about 26 m.y. old. The most distinctive volcanic unit is the newly named New Pass Tuff, a single cooling unit, about 22 m.y. old, recognized eastward in the Shoshone Mts., but not to the north. These rocks define the western part of a belt of late Oligocene-early Miocene silicic volcanism surrounding a core area of older Oligocene silicic volcanism. — *from* Authors' abstract

00660 **McLachlan, Dan, Jr.; Ehlers, Ernest G.** Effect of pressure on the melting temperature of metals: Jour. Geophys. Research, v. 76, no. 11, p. 2780-2789, illus., tables, 1971.

In this paper an equation is derived to relate the melting points of metals to the application of pressure on the basis of theory that an entrapped gaseous fraction comes

into being when a metal changes from the solid to the liquid state. A correlation is made between the parameters of this new equation and those of equations derived by F. E. Simon [1929] and G. C. Kennedy [1966-69]. The validity of the equation is tested by comparing its prediction with the experimental data obtained for Li, Na, K. Rb, Fe, and Ni, and the expected limitations of the equation are discussed. — Authors' abstract

00697 **McLachlan, Dan, Jr.** The use of deep-field microscopy in crystal morphology: Jour. Crystal Growth, v. 8, no. 4, p. 363-371, illus., 1971.

This paper discusses for the first time the limitations of the deep-field microscope from the standpoint of the *breadth* of field as well as the usual consideration of depth of field, with particular consideration of its use in observing the morphology of grown crystals. Of special consideration in studies of crystal habit is the use of this instrument for goniometry, that is, the measurement of interfacial angles by means of contours produced on the picture of the crystal. The contours are formed by applying a beam chopper to the optical slit system illuminating the sample. — Author's abstract

McNellis, Jesse M. *See* Morgan, Charles O. 00942

Meehan, J. F. *See* Moran, D. F. 00635

08365 **Meisler, Harold; Becher, Albert E.** Hydrogeology of the carbonate rocks of the Lancaster 15-minute quadrangle, southeastern Pennsylvania: Pennsylvania Geol. Survey Bull. W26, 149 p., illus., tables, geol. map, 1970.

Cambrian and Ordovician limestone and dolomite strata underlie the Conestoga Valley lowlands, southeastern Pennsylvania. In Lancaster quadrangle carbonate strata are divided into 14 units on the basis of relative proportions of limestone and dolomite. Continuous or recurring deformation from Middle Cambrian to Triassic time has produced a complex structural pattern in the carbonates; structures and sequence of tectonic events are described. Ground water occurs in bedding and cleavage planes, joints, faults, and openings enlarged by solution; density, size, and extent of interconnection of openings determine transmissibility and storage capacity of rocks. For public supply and industrial use, the Stonehenge Formation is a very good source of water; for small public supplies and some industrial uses, the Stonehenge and Ledger Formations are very good sources. — VSN

Mele, Frank Michael. *See* Navarra, John Gabriel. 00766

08394 **Mellor, Malcolm.** Phase composition of pore water in cold rocks: U.S. Army Corps Engineers Cold Regions Research and Eng. Lab. Research Rept. 292, 61 p., illus., tables, 1970.

Phase composition of pore water in three rock types subjected to temperatures below 0°C was explored by a variety of techniques. Freezing point depression was measured as a function of water content by differential thermal analysis, results yielding relations between unfrozen water content and temperature. To avoid practical difficulties involved in differential thermal analysis, attempts were made to determine freezing characteristics indirectly by air and mercury penetration techniques. Electrical conductivity measurements were made as a function of temperature down to -195°C for information on characteristics of interfacial water films at low temperatures. Thermal strain was measured as a function of temperature to detect direct mechanical effects associated with phase changes. Finally, isothermal compressibility measures, up to 27 kb, were made at -10°C to determine step changes in volumetric stain in the rock. — *from* Author's abstract

Melton, Frank A. *See* Speer, John H. 00863

Menard, H. W. *See* Chase, T. E. 08323

00646 **Merewether, E. A.** Geology of the Knoxville and Delaware quadrangles, Johnson and Logan Counties and vicinity, Arkansas: U.S. Geol. Survey Prof. Paper 657-B, 18 p., illus., tables, geol. map, 1971.

Sedimentary rocks of Pennsylvanian age crop out, and are penetrated by wells drilled for gas, in the Knoxville and Delaware quadrangles of northwestern Arkansas. These rocks, in the Morrow, Atoka, and Des Moines Series, consist of sandstone, siltstone, and shale, and a few beds of coal and limestone. They have been folded into gently dipping westward-trending anticlines and synclines, and broken by northward- or southward-dipping normal faults. The reported initial potential production of gas (Oct. 31, 1967) in the area is about 248 million cu ft per day from sandstones of the Atoka Series. The Lower Hartshorne coal bed in the Des Moines Series contains an estimated reserve of about 2 million short tons of coal, ranging in rank from low-volatile bituminous to semianthracite. — EAM

00714 **Merewether, E. A.** Geologic map of the Wild Horse Mountain quadrangle, Carbon County, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-887, scale 1:24,000, sections, 1971.

Meyer, Charles F. *See* Todd, David K. 00837

Meyer, W. C. *See* Gorsline, D. S. 00743

Mikulich, M. J. *See* Shuey, R. T. 08206

08264 **Milfred, Clarence J.; Hole, Francis D.** Soils of Jefferson County, Wisconsin: Wisconsin Univ. Geol. and Nat. History Survey Soil Survey Div. Bull. 86, Ser. 61; 172 p., illus., tables, 1970.

Jefferson County in southeastern Wisconsin is part of a rolling till plain studded with southerly-oriented drumlins and indented with wetlands and with lakes associated with outwash sand and gravel deposits on the west and east. The southeast corner of the county lies in the rugged Kettle Moraine. Because of the thick glacial drift, outcrops of the extensive Paleozoic dolomitic limestones are few. Soils developed from a discontinuous loess covering, glacial till, outwash, lake-laid deposits, and peat and bogland muck, and range from gravelly sandy loams on kames to black silty clay loams and mucks in the lowlands. Upland soils constitute areas of ground-water recharge and lowland soils are areas of gradual discharge of runoff water. Peat mounds and flowing wells attest to the abundance of water at the lower elevations. — *from* Authors' abstract

00931 **Miller, Charles N., Jr.** Evolution of the fern family Osmundaceae based on anatomical studies: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 8, p. 105-169, illus., tables, 1971.

Phylogenetic relations of living and extinct Osmundaceae are interpreted from anatomical and morphological characters of their stems, leaf-bases, and roots. The 16 living species, and 29 species based on petrified axes, are classified under subfamily Thamnopteroidea for Permian protostelic forms (7 genera, 11 species), and under Osmundoideae for Triassic to living forms, with modified dictyoxylic-siphonostele organization. Species were analyzed by the ground plan method of multiple character correlation and arranged according to lines of specialization from which, when plotted against geologic time, nine species-groups are resolved: living and fossil forms of *Osmunda*, *Osmundastrum*, *Plenasium*, *Todea*, *Leptopteris*; three groups of *Osmundacaulis* (Mesozoic axes not assignable to the above genera); and the thamnopteroids. — VMJ

00881 **Miller, F. K.; McKee, E. H.** Thrust and strike-slip faulting in the Plomosa Mountains, southwestern Arizona: Geol. Soc. America Bull., v. 82, no. 3, p. 717-722, illus., table, 1971.

Thrust and strike-slip faulting are recognized in the Plomosa Mountains, southwestern Arizona. The distribution of rock types and the geometry of the thrust faults necessitate that the upper plate moved from east to west. The amount of displacement is not known, but is considered to be large. Apparent separations along the strike-slip faults are in a right-lateral sense and are greater than 19,000 feet. Rhyodacite flows, dated by K-Ar methods at 19 to 20 m.y., unconformably overlie the thrust faults and are cut by the strike-slip faults. — Authors' abstract

00875 **Milliman, John D.; Gastner, Manfred; Mëller, Jens.** Utilization of magnesium in coralline algae: Geol. Soc. America Bull., v. 82, no. 3, p. 573-579, illus., tables, 1971.

Most coralline algae contain considerably more magnesium in their calcitic skeletons than can be explained by the shift in their X-ray diffraction peaks. Part of this excess magnesium is explained by local concentrations of higher magnesian calcite within the skeleton. Utilization of these higher magnesian phases may have generic and ecologic implications. Data also suggest that an additional phase, perhaps brucite, may be responsible for the remainder of the excess magnesium. — Authors' abstract

Milne, V. G. *See* Ayres, L. D. 00870

Milne, V. G. *See* Ayres, L. D. 00871

Milne, V. G. *See* Ayres, L. D. 00872

Milne, V. G. *See* Ayres, L. D. 00873

08118 **Milne, W. G.** The Snipe Lake, Alberta earthquake of March 8, 1970: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1564-1567, illus., tables, 1970.

An earthquake of magnitude 5.1 occurred on March 8, 1970 at an unusual location in north central Alberta, Canada. The epicentral coordinates obtained from a study of seismic records and the center of the "felt" report area indicate an epicenter near Snipe Lake. Past data indicate that an earthquake in this eastern Cordillera is a very rare event. No change appears to be needed for the seismic probability map of the 1970 National Building Code. — Author's abstract

Minster, J. B. *See* Kamb, Barclay. 00612

Minster, J. Bernard. *See* Hanks, Thomas C. 00644

Mixon, R. B. *See* Southwick, D. L. 00936

00751 **Mizutani, Hitoshi.** Discussion of paper by O. L. Anderson, "Elastic constants of the central force model for three cubic structures — Pressure derivatives and equations of state" [1970]: Jour. Geophys. Research, v. 76, no. 11, p. 2796-2797, 1971.

The paper under discussion was published in Jour. Geophys. Research, v. 75, no. 14, p. 2719-2740, 1970; *see* Abs. North American Geology, this issue.

00738 **Moench, Allen.** Ground-water fluctuations in response to arbitrary pumpage: Ground Water, v. 9, no. 2, p. 4-8, illus., 1971.

The problem of predicting water level changes in an aquifer due to variable pumpage is approached by using the convolution integral. Equations for a nonleaky artesian aquifer and a leaky artesian aquifer with negligible storage in the confining layer are presented. Computational results compare favorably with type curves for hypothetical cases with constant pumping. A practical example using variable pumpage from several pumping centers shows the applicability of the technique and its value in interpreting water level variations. — Author's abstract

Mogilevskii, I. I. *See* Solopov, S. G. 08256

Moller, J. *See* Dansgaard, W. 08209

00659 **Monroe, Watson H.** Geologic map of the Manatí quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-671, scale 1:20,000, text, revised 1971; originally published as Map I-334, 1962.

Refinements of stratigraphy are the main differences between this map and that of 1962. One of the best examples of doline karst in the island is found in the outcrop belt of the Aguada Limestone; further north this belt grades into a characteristic mogote karst. Structure contours are drawn on the top of Aguada Limestone.

Economic mineral deposits are limestone, possible dolomite, and silica sand. Landslide deposits along the Río Grande de Manatí and Rio Indio consist mainly of blocks of Aguada Limestone. – ESL

00800 **Montana Water Resources Board.** Water resources survey, Valley County, Montana — Pt. 1, History of land and water use on irrigated areas; Pt. 2, Maps showing irrigated areas in colors designating the sources of supply: Helena, Montana, Montana Water Resources Board, Pt. 1, 71 p., illus., tables; Pt. 2, 53 p. of maps, 1971.

Montgomery, A. *See* Keidel, F. A. 00911

08345 **Montgomery, Arthur.** Swarthmore-Leidy collection, Pt. 2: Mineralog. Rec., v. 1, no. 3, p. 84, 86, 91, 126, 1970.

In this conclusion to the report on the Leidy mineral collection (ibid., no. 2, 1970) some of the finest of 500 specimens, small to medium size and 90 percent characterized by excellent, sharply-formed crystals, are singled out in a listing, with locality and other names as well as brief descriptive terms. Selected in two groups are: extrafine crystallized specimens from European as well as North American localities; and specimens of good to first class quality from well-represented North American localities. Rare minerals are almost totally absent in the collection which represents about 200 of the commonest species. (See Abs. North American Geology, March 1971, for Part 1). — GDC

Moore, George W. *See* Clifton, H. Edward. 00622

Moore, Gerald K. *See* Burchett, Charles R. 00793

00756 **Moore, James G.** Relationship between subsidence and volcanic load, Hawaii: Bull. Volcanol., v. 34, no. 2, p. 562-576, illus., table, 1971.

Computer analysis of tide-gage records in the northeast Pacific indicates that active volcanic islands of eastern Hawaii are subsiding faster than eustatic rise of sea level, the rate of subsidence increasing progressively toward the center of current activity on the Island of Hawaii. Subsidence apparently is related to downbowing of the crust under the weight of volcanic material added by active volcanoes. The Hawaiian Arch encircles the subsiding zone and may be uplifted by material moving down and outward from the zone of subsidence. The great excess of subsidence (270 million cu m annually) over volcanic addition (50 million cu m annually) cannot be reconciled with isostatic models, and apparently is the result of other processes operating in the volcano and its basement that are poorly understood. Intrusion and submarine volcanism provide additional unseen load, while the volume of subsidence may be overestimated due to local downslope movement of island margins. — DBV

Mooser, F. *See* Gunn, B. M. 00757

00635 **Moran, D. F.; Allen, Clarence; Brugger, W. A.; Crandall, L. Leroy; Degenkolb, H. J.; Duke, C. M.; Meehan, J. F.; Pinkham, C. W.; Wallace, Robert E.; Steinbrugge, Karl V.** Introduction to the engineering study, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 182-185, illus., 1971.

This earthquake provided the first real test of earthquake-resistive construction as it is practiced in California. Many structures failed the test; three major multistory buildings were hospitals, and all had to be evacuated owing to severe structural damage. Several freeway-bridge collapses required closing of major freeways and a railway; residential and apartment damage was heavy, and overall economic loss is estimated at one billion dollars. Exact cause of damage to many structures may never be known, but strong evidence exists of severe vertical accelerations which could have contributed to increased damage from this moderate magnitude shock. — VSN

00942 **Morgan, Charles O.; McNellis, Jesse M.** Reduction of lithologic-log data to numbers for use in the digital computer: Jour. Internat. Assoc. Math. Geology, v. 3, no. 1, p. 79-86, tables, 1971.

The development of a standardized system for conveniently coding lithologic-log data for use in the digital computer has long been needed. The technique suggested involves a reduction of the original written alphanumeric log to a numeric log by use of computer programs. This numeric log can then be retrieved as a written log, interrogated for pertinent information, or analyzed statistically. — Authors' abstract

Morgan, James J. *See* Stumm, Werner. 08400

Morgan, W. R. *See* Blount, C. W. 00909

08241 **Morita, H.** Polyphenols in the extractives of an organic soil [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 28-31, illus., 1970.

The simpler phenolic compounds occurring in plants are briefly reviewed. Methods for the analyses of the phenolic moieties in plant extracts are cited. Some of the established methods of analyses have been applied to the hot water, pyrophosphate, benzene/alcohol and acetone extractives of a peat soil. The results indicate the presence of a variety of known plant phenolic compounds in the soil of which p-coumaric acid and ferulic acid are the most prominent ones. The simple phenolic moieties in *Sphagnum* have also been examined. — Author's abstract

08233 **Morley, L. W.** Reconnaissance aerogeophysical mapping in mineral areas, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 82-90, illus. [1970].

This paper discusses airborne magnetometer surveying in Canada by the Federal Government and by oil companies, resulting in the publication of over 5,000 aeromagnetic maps at the scale of 1 inch to a mile, mostly of mineral-bearing terrain, with a line-spacing of one-half mile. Aeromagnetic reconnaissance of Alaska has covered chiefly the sedimentary basins and relatively low-relief areas. Canada's experience in surveying mountainous terrain with poor weather conditions is cited, and methods are recommended which could be used by the United States in similar terrain in Alaska. — EH

00734 **Mörner, Nils-Axel.** Eustatic changes during the last 20,000 years and a method of separating the isostatic and eustatic factors in an uplifted area: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 9, no. 3, p. 153-181, illus., tables, 1971.

For the period 11,750-200 B.C., the eustatic curve is derived from southern Scandinavia by calculation of the eustatic and isostatic factors, respectively, in shore-level displacement curves from several points in the direction of tilting from strongly uplifted to slightly subsided isobase latitudes. The eustatic curve obtained is highly fluctuating, though with small amplitude. The present position was reached 1,700-1,400 B.C. With information from Vendsyssel, the Gulf of Mexico, and the shelf off northeast America (excluding isostatic factor) the eustatic curve was extended back in time to the glaciation maximum at about 18,000 B.C., where eustatic sea level was about -85-90 m. At 13,000-12,800 B.C., a 10-m drop in sea level was found, corresponding to the second glaciation maximum during Late Wurm-Weichsel-Wisconsin. — *from* Author's abstract

00887 **Mörner, Nils-Axel.** Relations between ocean, glacial, and crustal changes: Geol. Soc. America Bull., v. 82, no. 3, p. 787-788, illus., 1971.

Ocean, glacial and crustal changes are related in a much more complex fashion than has been generally recognized. The relations are presented schematically, and it is concluded that studies of uplifted areas may be the only means for separating isostatic and eustatic changes. — Author's abstract

00947 **Mörner, Nils-Axel.** Eustatic and climatic oscillations: Arctic and Alpine Research, v. 3, no. 2, p. 167-171, illus., table, 1971.

Several different methods indicate global climatic oscillations to be well established not only for the Late Glacial period but also for the whole of the Postglacial (Flandri-

an, Holocene) period. These oscillations were drastic enough to affect the ocean level even during the last 6,000 years when only minor glaciated areas were left after the last ice age. A low amplitude oscillating eustatic curve during the Holocene is in full concordance with the climatic and glacier changes found. Therefore, smooth 'eustatic' curves (type Shepard's curve) are considered overgeneralized or based on incomplete information. — *from* Author's abstract

00634 **Morrill, B. J.** Evidence of record vertical accelerations at Kagel Canyon during the earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 177-181, illus., 1971.

The largest vertical accelerations recorded by a strong-motion seismograph during the earthquake were in the range 0.5-0.75 g at Pacoima Dam 5 mi from the epicenter and 2.75 mi from the Kagel Canyon Fire Station. Evidence noted at this fire house suggests that the acceleration exceeded that of gravity and may have equaled or exceeded that of the great Assam earthquake, June 12, 1897, in very local situations. Catastrophic damage to equipment at the fire house and in the immmediate area of the earthquake is described briefly. — VSN

00853 **Morris, Robert C.** Stratigraphy and sedimentology of Jackfork Group, Arkansas: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 387-402, illus., table, 1971.

The Jackfork Group is a flysch deposit which crops out along the frontal Ouachita Mts. and the Athens Plateau of Arkansas. The 5400-ft section along the Ouachitas is 70 percent shale, contorted by soft-sediment deformation. Two new formations [Iron Fork Mountain and Brush Knob Formations] of about equal thickness are proposed. On the Athens Plateau, the group is 6000 feet thick and consists of 70 percent wackes and arenites. Pitkin Limestone exotics in underlying Chickasaw Creek Formation suggest that the Jackfork was deposited during formation of the Pitkin-Hale unconformity. Differences in thickness, mineral composition, sedimentary structures, and sand-shale permit construction of a depositional model. —*from* Author's abstract

00767 **Morrow, N. R.** The retention of connate water in hydrocarbon reservoirs — Pt. 1, Review of basic principles: Jour. Canadian Petroleum Technology, v. 10, no. 1, p. 38-46, illus., 1971.

Application of capillary pressure data to determination of connate water distributions in hydrocarbon reservoirs is reviewed. Leverett (1941) assumed that capillary equilibrium would be achieved after geologic time. The fair agreement of water saturations or cores taken with oil-base muds from above the transition zone with laboratory-measured irreducible saturations has been claimed as support for this theory. In fact, this agreement is strong evidence that the reservoir does not drain to a capillary equilibrium distribution even after geologic time. The basis for using capillary pressure tests must, therefore, rest largely on the fair empirical agreement observed between water saturations of cores taken with oil-base muds and the irreducible saturations of cores. Capillary equilibrium can be expected in the transition zone, but prediction of fluid distribution in this zone is uncertain because of capillary pressure hysteresis. — *from* Author's abstract

00768 **Morrow, N. R.** The retention of connate water in hydrocarbon reservoirs — Pt. 2, Environment and properties of connate water: Jour. Canadian Petroleum Technology, v. 10, no. 1, p. 47-55, illus., 1971.

The quantity of connate water held in hydrocarbon reservoirs by adsorption depends on clay contents of reservoir rocks and is roughly 2 percent of the spore space saturation. As saturations commonly range from 15 to 50 percent, most water will be in its normal bulk state. Above the transition zone, estimated bulk-water saturation corresponding with capillary equilibrium rapidly approaches zero with height. Thus, measured irreducible saturations exceed capillary equilibrium saturations by an amount almost equal to the irreducible saturation. A possible reason for failure of reservoirs to achieve capillary equilibrium by diffusion is that upward diffusion of water due to geothermal gradient will dominate over downward diffusion due to

gravity. Above the transition zone, formation resistivity is probably dominated by conductance of drained rock surfaces. — *from* Author's abstract

00848 **Morrow, Norman R.** Small-scale packing heterogeneities in porous sedimentary rocks: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 514-522, illus., table, 1971.

Packing heterogeneity is defined as local variation in sorting, or more strictly, local variation in pore-size distribution. Small-scale packing heterogeneities essentially determine the amount of liquid which is held as an irreducible wetting phase saturation in a drained porous rock. The so-called irreducible saturations of two unconsolidated core samples were reduced by approximately half after the particles of each core had been well mixed to destroy small-scale packing heterogeneities. Irreducible saturation is proposed as an index of packing heterogeneity, which may reflect depositional environment and post-depositional history. — Author's abstract

00620 **Morton, Douglas M.** Seismically triggered landslides in the area above the San Fernando Valley, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 99-104, illus., 1971.

A preliminary interpretation is given of aerial photographs of landslides triggered by the San Fernando earthquake. Photographs used included black-and-white photos taken on the day of the earthquake and color photos taken on February 18, 1971. More than 1,000 landslides were triggered in a 250 sq km area in hilly and mountainous terrane north of the San Fernando Valley. Gross distribution of slides was controlled by intensity of ground shaking, but local variations in density reflect variations in character and structural history of local geologic formations. Areas of highly fractured rock produced by the earthquake, especially along ridge tops, may give rise to future landslides if they receive sufficient moisture. Landslides are concentrated south-southwest of the epicenter of the main shock and within the area of principal aftershocks. — VSN

00789 **Morton, Douglas M.** Seismically triggered landslides above San Fernando Valley: California Geology, v. 24, nos. 4-5, p. 81-82, illus., 1971.

More than 1,000 landslides, distributed over a 100-sq-mi portion of hilly and mountainous terrane above San Fernando Valley, were triggered by the San Fernando earthquake and its aftershocks; overall distribution was determined by intensity of ground shaking, and local density reflected differing local geology. Landslides ranged in length from about 50 to more than 1,000 feet. Surficial debris slides and avalanches are the most widespread type of failure, particularly in areas of sedimentary rocks. Rockfalls were common on steep canyon walls in well-fractured basement rock. Soil falls were mainly on steeper faces of recent stream terrace deposits along major streams, and slumps were reactivated pre-earthquake slumps. No large rotational or complex slides were triggered. Lithologic control of landslides in the Lopez Canyon area is illustrated on a map. — VSN

Moston, R. P. *See* Johnson, A. I. 00819

08420 **Mothersill, John S.** Relationship of grain-size modes to nearshore sedimentary environments, Lake Superior, Ontario: Canadian Jour. Earth Sci., v. 7, no. 2, pt. 1, p. 522-527, illus., 1970.

Longshore troughs and bars at Batchawana and Pancake Bays show that the longshore-trough areas were formed by plunging waves that winnowed the finer sand which was then moved lakeward by undertow to build up longshore bars. Longshore trough samples have unimodal or bimodal grain-size distribution, whereas the bar samples always have unimodal distribution. The trough samples were largely negatively skewed. The bar samples were finer grained, well-sorted, and unimodal, and showed a strong tendency towards positive skewness. — *from* Author's abstract

08317 **Moussa, Mounir T.; Smith, Alan Lewis.** (compilers). Status of geological research in the Caribbean, No. 16: Mayaguez, Puerto Rico, Puerto Rico Univ. Inst. Caribbean Sci., 87 p., 1970.

This report lists geological research projects underway in the Caribbean region alphabetically by investigator; a regional index is included. Papers published or in press in 1970 and past publications available are listed. — VSN

Moyle, W. R., Jr. *See* Waananen, A. O. 00624

00882 **Muffler, L. J. P.; White, D. E.; Truesdell, A. H.** Hydrothermal explosion craters in Yellowstone National Park: Geol. Soc. America Bull., v. 82, no. 3, p. 723-740, illus., 1971.

Several craters from a few tens to about 5,000 feet across are believed to have resulted from explosive change of water to steam caused by sudden reduction of pressure on water saturated rocks that were near the boiling point. The heat energy was transferred from depth to the saturated rocks by circulating meteoric water. The reduction in pressure seems to have resulted from sudden draining of overlying ice dammed lakes during Pleistocene time. — WHN

08124 **Mukherji, K. K.; Winder, C. G.** Regional microfabric analysis and insoluble residues of Black River Group (Middle Ordovician) in southern Ontario: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1437-1448, illus., tables, 1970.

Carbonates of the Middle Ordovician Black River Group across the outcrop in southern Ontario have a fabric of elongate particles trending consistently in NW-SE and NE-SW directions. The origin of the fabric is considered primarily resulting from longshore currents in a shallow basin influenced by tidal activity. Insoluble residues constitute a small portion of the rock mass, but contain a wide range of mineral species. Although their distribution is sporadic, suites of minerals east and west of Marmora contain distinctive species. Generally, the detrital minerals seem to reflect the Precambrian source area to the north of the Paleozoic outcrop. A higher concentration of anhydrite to the east is interpreted as indicative of an area of more restricted marine conditions. — Authors' abstract

Muller, Jens. *See* Milliman, John D. 00875

Murase, T. *See* McBirney, A. R. 00760

00843 **Murphy, Richard E.** Structural landform regions of the world: Assoc. Am. Geographers Proc., v. 3, p. 122-127, illus., 1971.

Map Supplement No. 9 which appeared with the March, 1968, issue of the *Annals* of the AAG was the visual result of a classification composed of three basic elements of landform distribution: structural regions, topographical regions, and erosional-depositional regions. This paper explains the reasoning involved in the definitions and limitations for the structural regional types. Each of the 7 categories chosen involves combinations of 2 or 3 of the basic structural factors of rock type, geologic age, and diastrophic activity. Recognized structural regions, including shields, orogenic zones, and undisturbed sedimentary areas are given specific definitions and are mapped, thus producing the first of the 3 maps which were combined for the composite map of "Landforms of the World." The 7 structural regions provide an orderly framework for study of basic landform patterns and associated phenomena of the Earth. — *from* Author's abstract

08191 **Murrmann, R. P.; Winters, R. W.; Martin, T. G.** Gamma-ray spectra of resonance neutron irradiated earth materials: U.S. Army Corps Engineers Cold Regions Research and Eng. Lab. Research Rept. 289, 27 p., illus., tables, 1970.

Clay mineral and soil samples were subjected to neutron activation analysis in order to identify and measure abundances of trace elements having radionuclides with long half-lives. After exposure of cadmium-shielded samples to neutrons for a period of 5 days, the gamma radiation associated with the decay of resulting radionuclides was observed using a high resolution Ge (Li) detector. Elements identified without prior chemical separation using the gross gamma-ray spectra included Fe, Zn, Ti, Ni, Co, Cr, Sr, Ba, Ca, La, Eu, Tb, Hf, Ta, Th, and U. It should be possible to determine quantitatively the amount of each element. This is an improvement over the number

of elements determined in soils by activation analysis without destructive chemical treatments.—*from* Authors' abstract

08267 **Murthy, V. Rama; Griffin, W. L.** K/Rb fractionation by plagioclase feldspars: Chem. Geology, v. 6, no. 4, p. 265-271, illus., table, 1970.

Calcic plagioclases from basaltic-gabbroic rocks and anorthosites exhibit a strong fractionation of K and Rb. The trend of K/Rb ratio with K content is similar to that shown by oceanic tholeiites. Such a K-Rb relationship is not shown by metamorphic plagioclase. High K/Rb ratios in gabbroic or anorthositic rocks may not indicate a "-mantle" origin but may only reflect partitioning of K and Rb between liquid and plagioclase. The K/Rb ratios in stone meteorites appear to be largely controlled by their constituent plagioclase. — Authors' summary

00679 **Muskatt, Herman S.** A fold model that shows various outcrop patterns: Jour. Geol. Education, v. 19, no. 2, p. 82-83, illus., 1971.

Students often have difficulty in visualizing the three-dimensional aspect of a breached fold when only the outcrop pattern is seen. With this simple plastic model, they can see not only the fold, but the outcrop pattern of a breached fold, plunging or overturned, when the shaped plastic is placed in a container of water. The outcrop pattern is seen in the plane of intersection between water surface and model. — ESL

Muxart, R. *See* Corbel, J. 08201

00666 **Naidu, P. S.** Statistical structure of geomagnetic field reversals: Jour. Geophys. Research, v. 76, no. 11, p. 2649-2662, illus., table, 1971.

Geomagnetic polarity intervals determined from the analysis of the marine magnetic field have been subjected to statistical analysis. The major finding is that the statistical structure undergoes a discontinuous change around 50 m.y. ago. The polarity intervals from 0 to 48 m.y. form a stationary sequence and are governed by gamma distribution, but the intervals are not independent. The polarity intervals from 56 to 72 m.y., are also stationary and are governed by gamma distribution but have different parameters. The intervals appear to be independent. The above conclusions for the period 56 to 72 m.y. are, on account of limited data, somewhat tentative. The discontinuous change in the statistical structure appears to coincide with the worldwide tectonic activity of the early Eocene. — Author's abstract

00820 **Nair, Keshavan.** Analytical methods for predicting subsidence [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 588-595, illus. [1971].

The paper discusses the need for predictive methods in subsidence problems. The importance of correctly formulating the problem is emphasized. The various steps in formulating a problem are discussed. The finite element technique is considered to be the most useful technique for application to subsidence problems. The results of the analysis of an example problem using this technique are presented. — Author's abstract

Nandi, A. *See* Wynne-Edwards, H. R. 08121

00617 **Nason, Robert D.** Instrumental monitoring of postearthquake fault movements, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 89-90, illus., 1971.

Dip-slip creepmeters were installed at five sites on thrust faults resulting from the San Fernando earthquake on the day following the main shocks to measure postearthquake fault movement of "afterslip." In addition, a small fault monitoring pattern of survey marks was also established. Initial results indicate no observable afterslip. — VSN

00619 **Nason, Robert D.** Shattered earth at Wallaby Street, Sylmar, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 97-98, illus., 1971.

An unusual effect of the San Fernando earthquake is an area of shattered and overturned ground (unconsolidated terrace deposits) on a 15-ft-wide flat top of a ridge for a length of 200 feet. The ridge is in northeastern Sylmar and stands about 20 feet higher than Wallaby Street and 60 feet higher than a stream canyon to the east. The soil is loose to a depth of 1 to 2 feet becoming gradually harder like the original soil with increased depth. The very localized nature of the high acceleration indicated by this phenomenon may be from unknown effects of constructive interference of seismic waves arriving along different paths with focusing or concentration of energy at the narrowed-down ridge top; this wave interference and focusing patterns may be very important to distribution of strong shaking and related damage. — VSN

Natl. Oceanic Atmos. Admin. *See* U.S. Geological Survey. 00604

Nava, D. *See* Hart, S. R. 08270

00766 **Navarra, John Gabriel; Weisberg, Joseph S.; Mele, Frank Michael.** Earth science: New York and London, John Wiley and Sons, 488 p., illus., tables, 1971.

This textbook is designed as a nontechnical introduction to the study of earth science for the liberal arts student. Emphasis throughout the book is on environment and man's effect upon it. The text is divided into five units: the lithosphere, atmosphere, hydrosphere, biosphere, and space; each unit has four chapters. — VSN

00825 **Naylor, Richard S.** Acadian orogeny — An abrupt and brief event: Science, v. 172, no. 3983, p. 558-560, table, 1971.

Rubidium-strontium dating indicates the Barre-type granites in eastern Vermont were emplaced at least 380 m.y. ago. This result suggests the Acadian orogeny was more abrupt than previously suspected, and is consistent with the hypothesis that the orogeny involves a collision between two sialic plates. — Author's abstract

08417 **Nichols, Douglas James.** Palynology in relation to depositional environments of lignite in the Wilcox Group (early Tertiary) in Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 31, no. 6, p. 3491B, 1970.

08371 **Nicks, Oran W.** (editor). This island Earth: U.S. Natl. Aeronautics and Space Adm. Spec. Pub., SP-250, 182 p., illus., 1970.

Photographs of various aspects of the Earth and some of the Sun and the Moon taken primarily from Apollo spacecraft are presented and discussed. Photographs are grouped in seven sections: near a star called Sun, restless atmosphere, waters of Earth, lands of Earth, hand of man, across North America, and beyond this island Earth. — VSN

00927 **Nielsen, Grant LeRoy.** Hydrogeology of the Irrigation Study Basin, Oldman River drainage, Alberta, Canada: Brigham Young Univ. Geology Studies, v. 18, pt. 1, p. 3-98, illus., tables, 1971.

In this basin, perched water tables exist in low-permeability till and lacustrine deposits, and underlying gravels, valley-fill of a preglacial drainage system, drain to the Oldman River. Ground-water movement is from a recharge area in the Lethbridge Moraine to discharge areas along valleys peripheral to the basin. Flow profiles interpreted from piezometer records are compared to those created by electric analog and computer program. In an area of nonhomogeneous geology, the computer program can reduce the amount of drilling. Bedrock formations which are significant aquifers are limited to the Milk River Sandstone and Belly River Formation. The Saskatchewan Gravels, where saturated are an excellent aquifer. Total safe yield of ground water is about 5,800 i.g.p.m. for the basin. A water-well inventory and ground-water chemistry are given in appendices, and ground-water map is included. — ESL

08157 **Nininger, R. D.** Uranium reserves, future demand and the extent of the exploration problem, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 3-19, incl. discussion, illus., 1970.

Known world low-cost reserves, excluding the U.S.S.R., eastern Europe, and mainland China, are about one third of the estimated requirements through the rest of the century. Canada, South Africa, the United States and France control 85-90 percent of known reserves. Since ultimate requirements are of more importance to the Panel than the immediate supply and demand situation, we should be concerned with the many developing countries which will not require much, and have not been adequately explored, and could become suppliers of uranium over the next 30 years. Uranium geology is now at the stage where a flood of details about specific types of deposits is available, but has not been assimilated to bring cohesiveness to concepts of regional, tectonic, lithologic, and geochemical distribution. Meetings of this type can be instrumental in integrating some of these ideas. — *from* Author's abstract

00772 **Nitecki, Matthew H.** Amphispongieae, a new tribe of Paleozoic dasycladaceous algae: Fieldiana — Geology, v. 23, no. 2, p. 11-22, illus., 1971.

Amphispongia oblonga Salter, 1861, from the Upper Silurian (Ludlow) of Scotland, was originally described as a sponge, related to other receptaculitid genera, and forms the base of the lyssakid family Amphispongiidae Rouff, 1874. It was suggested by Finks (1967) that the fossil might be an alga, and *Amphispongia* is here redescribed as a dasycladaceous alga. A new tribe Amphispongiae (of the family Receptaculaceae) is erected, comprising *Amphispongia* Salter, 1861, and *Anomaloides* Ulrich, 1878. The latter, consisting of one species from the Upper Ordovician (Maysville) of Kentucky, was recently redescribed by Nitecki (1970) as a dasycladaceous alga in the receptaculitid tribe Cyclocriniteae. — VMJ

08274 **Noble, Donald C.; Hedge, Carl E.** Distribution of rubidium between sodic sanidine and natural silicic liquid: Contr. Mineralogy and Petrology, v. 29, no. 3, p. 234-241, illus., table, 1970.

Phenocrysts of sodic sanidine from 12 Cenozoic silicic ash-flow tuff and lava from the western U.S. contain from 0.25 to 0.45 the Rb present in associated groundmass materials. The K/Rb ratios in the sanadines are about four times those of the groundmass. Separation of phenocrystic sanidine from salic melts raises the Rb content and lowers the K/Rb ratio of the melts. Syenites of cumulate origin will have appreciably lower Rb contents and higher K/Rb ratios than the melts from which they precipitated. Available data on the distribution of Rb between synthetic biotite and K-sanidine demonstrate that the separation of the biotite probably will not deplete salic melts in Rb relative to K. — *from* Authors' abstract

Nordquist, J. M. *See* Allen, C. R. 00608

08173 **Nuffield, E. W.** Walter Wilson Moorhouse, 1913-1969: Royal Soc. Canada Minutes Proc. 1970, ser. 4, v. 8, p. 125-128, portrait, 1970.

00785 **Oakeshott, Gordon B.** California's changing landscapes — A guide to the geology of the state: New York and San Francisco, McGraw-Hill Book Company, 388 p., illus., tables, geol. map, 1971.

This book describes California's rocks, minerals, and geologic history for the use of amateur geologists; as background material for earth science teachers, engineers, planners, and government officials; and as a textbook for courses in junior colleges, and state colleges and universities. The text is in three parts: (1) Rocks, principles, and processes — uses California examples to discuss geologic principles, landform evolution, and important rock and mineral types; (2) California through the geologic ages — a chronologic account of California's geologic history; and geologic views and journeys in the natural provinces — guides viewers through the deserts, along the coast, and into the High Sierra. An extensive bibliography of supplemental information is included. — VSN

00904 **Oakeshott, Gordon B.** The geologic setting: California Geology, v. 24, nos. 4-5, p. 69-72, illus., 1971.

The San Fernando earthquake originated in a displacement along a reverse or thrust fault causing a block of the western San Gabriel Mts. (surface area at least 100 sq mi) to move relatively upward and southeastward about 4 feet vertically and 2 feet horizontally. Rock formations of these mountains include a great variety of types ranging from Precambrian igneous and metamorphic rocks to Holocene alluvium; these are described briefly and shown on a generalized geologic map. Structural features of the western San Gabriel Mts. are dominated by the near-vertical, right-lateral, strike-slip San Gabriel fault. The fault ruptures of this earthquake were in the block south of the San Gabriel fault in a series of discontinuous north-dipping reverse faults of the Santa Susana and Sierra Madre fault zones, and movements were essentially of the same pattern of uplift as that characterizing the Sierra Madre zone in the mid-Pleistocene (and still continuing) orogeny. — VSN

O'Connor, Howard G. *See* Burgat, Virgil A. 08414

00631 **O'Donnell, J. E.; Kaufmann, H. E.** Magnetic field survey of the San Fernando earthquake epicentral area, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 157-160, table, 1971.

Magnetic total field survey data for the epicentral area of the San Fernando earthquake are tabulated. The survey was conducted between February 23 and March 4, 1971, and since there are no previous magnetic data for comparison, a repeat survey will be made in the future. Changes noted at single stations occupied more than one time during the survey are discussed. — VSN

00669 **Olinger, Bart; Duba, Al.** Compression of olivine to 100 kilobars: Jour. Geophys. Research, v. 76, no. 11, p. 2610-2616, illus., table, 1971.

The compressions of the cell parameters of a natural olivine were studied to pressures greater than 100 kb using a high-pressure, in situ, X-ray powder-diffraction method. The a (smallest and the b (largest) cell parameters of orthorhombic olivine are found to have nearly the same compression values (X_p/X_o) to 100 kb and are more compressible than the c cell parameter. The subsequent volume calculations indicate that olivine is less compressible than has been reported from static work and from equation-of-state calculations based on ultrasonic elastic constant results. — Authors' abstract

Olsen, H. W. *See* Youd, T. L. 00625

00799 **Olson, Everett C.** Vertebrate paleozoology: New York, Wiley-Interscience, 839 p., illus., tables, 1971.

This book aims to present the problems and viewpoints of vertebrate paleozoology in the light of the kinds of materials available for study and the philosophical bases of the currently prevalent approaches. It is divided into two short and two long sections, treating: (1) the nature of the vertebrate record, the aims of research, and the extent to which the record and aims are compatible; (2) comparative and functional anatomy in studies of extinct vertebrates; (3) vertebrate classification systems, and how the history of discovery and the nature of the fossil record have influenced the classifications of different groups; (4) some of the major patterns of vertebrate evolution as revealed in the fossil record, with emphasis on vertebrates other than placental mammals, including adaptations to aquatic life, the water-land transition, and evolution of primitive mammals from reptiles, with a concluding chapter on paleobiogeography. — *from* Author's preface

08202 **Ongley, E. D.** Determination of rectilinear profile segments by automatic data processing [with German and French summaries]: Zeitschr. Geomorphologie, v. 14, no. 4, p. 383-391, illus., tables, 1970.

To enable the rapid isolation of rectilinear segments within individual profiles, a computer program in the Fortran IV language is described. Input consists of survey coordinates. The degree of variance of individual points within a rectilinear segment is controlled by the variable TOL which replaces an upper limit on the *residual distance* (Y-Yc) of all survey points. Operational procedure is described with specific reference to three possible point configurations within a profile data set. Examples of output are provided to allow a check for compatibility with other types of computers. — Author's summary

00688 **Orlansky, Ralph.** Palynology of the Upper Cretaceous Straight Cliffs Sandstone, Garfield County, Utah: Utah Geol. and Mineralog. Survey Bull. 89, 57 p., illus., tables, 1971.

Palynomorphs from land plants and associated microplankton from the Straight Cliffs Sandstone are illustrated and briefly described; 124 species — 59 dispersed spores, 30 gymnosperms, 28 angiosperms, and 7 dinoflagellate cysts — are stratigraphically allocated for the first time. Microplankton appear only in the lower member. Dispersed spores and gymnosperm pollen, occurring throughout the section, are mainly worldwide, long-ranging species. Angiosperm pollen grains occur throughout, but more commonly in middle and upper members, cooroborating the late Turonian and Coniacean age based on mollusks. The formation was deposited near the western strandline of the Western Interior seaway, the lower member in nearshore shallow marine waters; the middle, containing coal, in swamps and lagoons; the upper, thick sandstones, in streams. The angiosperm pollen probably represents upland vegetation. — *from* Author's abstract

08412 **Orlenok, V. V.** Rezul'taty seysmicheskikh issledovaniy v odnom iz rayonov Labradorskogo okeanicheskogo basseyna [Results of seismic investigations in one of the areas of the Labrador ocean basin] *in* Seysmicheskiye issledovaniya stroyeniya dna morey i okeanov: Akad. Nauk SSSR Inst. Okeanologii Trudy, v. 87, p. 76-85, illus., 1970.

This paper examines results of seismic reflection investigations on the southern part of the continental slope of the Labrador Sea. The unconsolidated sediments are not very thick on the whole, increasing from 300 m on the upper part of the continental slope to 600 m toward the center of the trough; semiconsolidated sediments are tentatively estimated as being 500 m thick. The two layers are quite different in structure, the difference being due either to differences in lithification or in lithology. Suspension currents evidently have affected deposition on this part of the continental slope, as testified by numerous interlayers which pinch out upward along the slope. A fault with vertical displacement of more than 100 m was recorded on one profile. — DBV

Ott, Welland L. *See* Lewis, Clyde L. 08280

00910 **Overbey, W. K., Jr.; Henniger, B. R.** History, development, and geology of oil fields in Hocking and Perry Counties, Ohio: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 183-203, illus., 1971.

Oil and gas accumulations in Hocking and Perry Counties, Ohio, are dependent on stratigraphic variation rather than structure. Reservoir parameters important to exploration are (1) interstitial clay content, (2) shale stringers and laminations, (3) degree of cementing, (4) grain size, (5) pore geometry, and (6) thickness. The best producing oil wells are those completed in thick shale-free distributary channel deposits and delta-platform tidal channels. — *from* Authors' abstract

08123 **Palmer, H. C.** Paleomagnetism and correlation of some Middle Keweenawan rocks, Lake Superior: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1410-1436, illus., tables, 1970.

Middle Keweenawan formations or magnetic divisions within formations can be correlated on the basis of magnetic polarity. The mean direction reflects a secondary component of magnetization which cannot be preferentially removed by alternating

field demagnetization and which has caused the non anti-parallel alignment of normal and reverse populations of magnetization. An estimate of the pole position during the Middle Keweenawan time can, however, be made by calculating a pole given equal weight with the mean normal and mean reverse pole. This is calculated to be 159° W., 42° N. — *from* Author's abstract

Palmer, James E. *See* Trace, Robert D. 00647

00929 **Pape, Lance W.** Geology and mineralogy of the Trump fissure-fault ore body, Trixie mine, East Tintic district, Utah: Brigham Young Univ. Geology Studies, v. 18, pt. 1, p. 115-145, illus., tables, 1971.

The Trump fissure-fault ore body is a siliceous copper-gold-silver fissure-filling deposit in the Trixie mine, East Tintic district, Utah. Ore is confined to the breccia zone of the Trump fissure-fault which is part of a larger fissure zone characterized by NNE-trending monzonite and pebble dikes, breccia zones, and hydrothermal alteration. Several stages of hydrothermal alteration in the Trump fissure-fault zone have prepared the Tintic Quartzite host for ore emplacement. Fissure-filling and replacement ores occur as a complex assemblage of primary and secondary sulfides, sulfosalts, carbonates, and sulfates. Paragenesis and zoning of the ore body are difficult to identify due to telescoping of minerals and variation of ore tenor. Favorable guides for exploration of Trump-type ore bodies are NNE-trending fissures, which have been hydrothermally-altered and contain monzonite and pebble dikes. — Author's abstract

08127 **Papezik, V. S.** Petrochemistry of volcanic rocks of the Harbour Main Group, Avalon Peninsula, Newfoundland: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1485-1498, illus., tables, 1970.

The rocks of this Proterozoic group include flows, pyroclastics, and several belts of well-preserved ignimbrites. Twenty-two recent chemical analyses of volcanic rocks, sixteen of them not previously published, show that the Harbour Main volcanic suite is distinctly sodic and weakly alkalic, ranging from basic rocks of the hawaiite-mugearite type to sodic rhyolites with relatively high alkalic content; the alkali-lime index of the suite is 52. The rocks are similar to the late Precambrian Uriconian volcanics in Britain. It is suggested that volcanic rocks of the Avalon Peninsula and British Midlands formed in different parts of a continuous tectonic belt during post-orogenic block-faulting of Basin and Range type prior to opening of the Atlantic Ocean. — *from* Author's abstract

08398 **Park, Charles F., Jr.; MacDiarmid, Roy A.** Ore deposits, 2d edition: San Francisco, Calif., W. H. Freeman and Company, 522 p., illus., tables, 1970.

Emphasis in this text, as in the first edition, is on exploration geology for the beginning geology student. Discussions of processes and descriptive examples have been revised to include recent developments and discoveries; lists of references at the end of each chapter have been updated; and short descriptions of Jamaican bauxite deposits and a chapter on metallogenic provinces and epochs have been added. The text has 21 chapters discussing modern theories of ore deposition; ore-bearing fluids; deposition, alteration, gangue, paragenesis and zoning, geothermometry, and classification of ore deposits; magmatic segregation, and pegmatite, igneous metamorphic, hypothermal, mesothermal, epithermal, telethermal, xenothermal, and sedimentary deposits; weathering; supergene sulfide enrichment; metamorphism of ores; and metallogenic provinces and epochs. — VSN

00898 **Park, I.; Clarke, D. B.; Johnson, J.; Keen, M. J.** Seaward extension of the West Greenland Tertiary volcanic province: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 235-238, illus., 1971.

Tertiary basalts from West Greenland and eastern Baffin Island, Canada, are important when considering the history of spreading in the North Atlantic, the Labrador Sea and Baffin Bay. They also form a significant part of the Brito-Arctic Tertiary volcanic province. Magnetic surveys at sea off Disko Island show that basalts of West

Greenland extend many tens of kilometers offshore forming a large part of the continental shelf, and on the shelf extend well north of the most northerly occurrences on land. The surveys also show the first evidence for sedimentary basins on the West Greenland shelf, akin to those of the Atlantic Coastal Plain of eastern North America. — *from* Authors' abstract

08166 **Park, J. K.** Acid leaching of red beds and the relative stability of the red and black magnetic components: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1087-1092, illus., tables, 1970.

A technique for leaching rock specimens with acid has been developed for the investigation of the magnetic properties of red sediments. The efficiency of the leaching depends strongly on the shape of the specimen, and cylindrical specimens with an axial hole were found to be the most suitable, both for the leaching process and for subsequent magnetic measurements. Applying the technique to Carboniferous red sandstones from the Maritime Provinces, two magnetic components were separated and identified with red and black constituents. The red magnetic component has higher blocking temperatures and coercivities than the black, and is more resistant to alternating field demagnetization. An earlier explanation of the magnetization of these red beds requires some modification. — Author's abstract

08167 **Park, J. K.; Irving, E.** The Mid-Atlantic Ridge near 45°N — [Pt.] 12, Coercivity, secondary magnetization, polarity, and thermal stability of dredge samples: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1499-1514, illus., tables, 1970.

The mean coercivities of natural, anhysteretic, and isothermal remanent magnetism of 34 samples of submarine basalt are 270, 250, and 370 oersteds, respectively, showing magnetization to be stable. Because of small secondary components, there are small differences in low coercive range (0 to 100 Oe). The magnitude and sign of the differences are used to derive an empirical relation between coercivity and magnitude of secondary components, and to infer polarity of primary components. The inferred polarities of samples from within the Median Valley of the Ridge are all normal, whereas both normal and reversed are found from adjacent mountains and plateaus, warming Median Valley specimens to 100°C for 90 h causes formation of a new component with a lower intensity and higher blocking temperature, but with the same directions. — *from* Authors' abstract

Park, J. K. *See* Brooke, J. 08168

Parker, A. *See* Macdonald, Raymond. 08219

Parry, William T. *See* Hedberg, Leonard L. 00794

00700 **Paterson, Norman R.; Ronka, Vaino.** Five years of surveying with the Very Low Frequency-Electro Magnetics method: Geoexploration, v. 9, no. 1, p. 7-26, illus., table, 1971.

Since first use of the VLF-E.M. method for surveying in 1964, hundreds of surveys have been carried out; several variations on the original design have been introduced; and the method has become airborne. The VLF instrument, a directional radio receiver, can be tuned to distant radio transmitters in the 15-25 kHz band. The first VLF instrument, measures vertical real and imaginary components of the magnetic field vector; the latter is useful in distinguishing between conductors lying at different depths below ground. Ground conductivity is also interpretable. Relative conductivity-thickness of a buried conductor affects the VLF response but is harder to interpret. The VLF-E.M. method is useful in surveying for massive sulfides and for geological mapping. It also may be useful in exploring for more disseminated ores, where suitable conductivity contrasts at these frequencies exist. — *from* Authors' abstract

08159 **Patterson, J. A.** Character of the United States uranium resources, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 117-127, illus., tables, 1970.

Uranium deposits are widespread in the western United States and occur in a variety of geologic environments. However, U.S. resources are preponderately in tabular disseminated deposits in sedimentary host rocks of the Colorado Plateau and the Wyoming basins. The deposits of the Plateau area are largely in sandstone of Jurassic or Triassic ages. In the Wyoming basins, the deposits are in sandstones of Tertiary age. The 3100 deposits reported are log normally distributed with a median size of only 2.5 short tons U_3O_8. The 25 largest deposits (over 3000 short tons of U_3O_8 each) contain about half the U.S. resources. Most known deposits are comparatively shallow, less than 700 feet deep, but important deposits are being found at depths exceeding 2000 feet. The ores are predominately uraninite and coffinite types. — Author's abstract

00693 **Patton, Thomas C.; Cheney, Eric S.** L-D gold mine, Wenatchee, Wash. — New structural interpretation and its utilization in future exploration: Soc. Mining Engineers AIME Trans., v. 250, no. 1, p. 6-11, illus., 1971.

Recognition of locally mappable conglomerates, sandstones, and shales within the Paleocene(?) Swauk formation led to discovery that the known epithermal gold mineralization is limited to a previously unknown imbricate thrust zone of unknown displacement cutting the open folds of the area of the L-D gold mine. Hypabyssal intrusions are most numerous along the trace of the thrust faults. Yakima basalt of Miocene age unconformably overlies the Swauk formation, thrust faults, and intrusions. From 1949 until January 1967, when the mine closed, 1,036,572 dry tons of ore valued at 14,962,305 dollars, averaging 0.396 oz Au and 0.607 oz Ag per ton were mined. Recognition of structural control of mineralization and alteration within the Swauk suggest several areas within and outside of the mine for further exploration. — *from* Authors' abstract

08363 **Patton, Thomas H.; Webb, S. David.** Fossil vertebrate deposits in Florida: Plaster Jacket, no. 14, [8] p., illus., 1970.

In a popular guide, vertebrate faunas of Florida are summarized and localities plotted on index maps for each series from Eocene through Pleistocene. Paleoecology and geologic conditions favoring deposition and preservation of fossil vertebrates in the most productive localities are briefly but adequately explained. — VMJ

08227 **Pecora, William T.** The need for mapping and inventorying natural resources, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 30-32 [1970].

This paper stresses the difficulty in acquiring data on the geology and natural resources of Alaska due to the severe climate and complex geologic history of the area. It is the responsibility of the Federal and State Governments, who own most of the land in Alaska, to make decisions on the development of the State's resources. A case history of the discovery of the colossal petroleum resource at Prudhoe Bay, Alaska, and of subsequent problems involved in transporting the petroleum over permafrost terrain is given. The necessity of obtaining accurate and complete terrain information before construction of a pipeline can be authorized is emphasized. Airborne magnetometer analysis, topographic mapping, satellite photography and remote sensing are valuable ways of obtaining this information. — EH

Peres, J. *See* Revelle, R. 08382

08307 **Perkins, Bob F.** (editor). Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, 141 p., illus., tables, 1970.

Geoscience and Man has been initiated by the School of Geoscience for publication of symposia, monographic studies, and collections of papers in anthropology, archeology, geography, geology, meteorology, paleontology, and other areas of the geosciences. This volume contains eight papers, all but two of which are cited separately, and nine abstracts, all of which are cited separately. — ESL

Perkins, R. W. *See* Silker, W. B. 00859

00662 **Perret, William R.** Jorum early aftershock measurements: Jour. Geophys. Research, v. 76, no. 11, p. 2730-2734, illus., tables, 1971.

An instrumentation system devised specifically to aid in differentiating the locus of early aftershocks in the vicinity of a large underground nuclear explosion was tested during the Jorum event in September 1969. This system included six stations located on three radii from Jorum surface zero. Records from these stations included 115 aftershocks during the initial three-hour postshot period. Arrival times from the 40 largest events during the first hour indicated that 12 were in the chimney area, and 28 were at distances between 100 m and 6.3 km from the explosion. Six events appear to be directly associated with faults identified prior to the shock, and two groups near surface zero suggest new faults in that vicinity. Four later aftershocks were found to be within the chimney area. — *from* Author's abstract

00968 **Pessagno, Emile A., Jr.** Jurassic and Cretaceous Hagiastridae from the Blake-Bahama Basin (Site 5A, JOIDES Leg I) and the Great Valley Sequence, California Coast Ranges: Bulls. Am. Paleontology, v. 60, no. 264, 83 p., illus., 1971.

The Hagiastridae Riedel include Spongodiscacea with two, three, or four-rayed tests comprised of layered spongy meshwork lacking concentric rings or spirals. This family appears to be restricted to the Mesozoic. It has a lengthy geologic history which extends at least as far back as the Jurassic. The majority of hagiastrid species are distinctive and short ranging. Twenty-four new species and four new genera are described herein from the Upper Cretaceous portion of the Great Valley Sequence, California Coast Ranges. Four new species are described from the late Jurassic (Tithonian) strata of the Blake-Bahama Basin (Site 5A, JOIDES Leg I). In this report Spumellariina with spongy meshwork, regardless of test shape, have been placed in the superfamily Spongodiscacea Haeckel. — Author's abstract

Peterman, Z. E. *See* Rosholt, J. N. 08423

08299 **Peters, W. C.** (editor). Mining and ecology in the arid environment — Conf., Tucson, Arizona, 1970, Proc: Tucson, Arizona, University of Arizona, College of Mines, 229 p., illus. [1970].

The interdisciplinary conference on mining and ecology in the arid environment, held March 22-27, 1970, in Tucson, Arizona, and presented by the Department of Mining and Geological Engineering, College of Mines, University of Arizona, was designed with the view of minimizing the adverse influence of mining engineering on the environment. These proceedings are a record of the lectures, discussions and field trips of the conference which was divided into sessions on perspective, air, water, land, control and design, and evaluation. Field trip notes are included in an appendix. Three of the papers are cited separately in this volume. — EH

Petersen, Ole V. *See* Sorensen, Henning. 08293

00811 **Peterson, Frank L.; Davis, Stanley N.** Short-term movement of the land surface near water wells [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNECO), p. 360-367, illus. [1971].

Stresses related to short-term pumping (or injecting) water from wells result in measurable movements of the land surface. Sensitive transducers coupled to horizontal and vertical extensometers enable relative movements to be measured with a precision of 0.1 micron. Results from 196 tests on 19 wells indicate the following: (1) Total vertical movement probably ranged between 1 and 100 microns on most tests, and horizontal movement was as great as 15 microns per meter of lateral distance; (2) with only one exception, short-term effects were almost perfectly elastic; (3) pumping and injecting equal amounts of water produced movements of similar magnitude but in opposite directions; and (4) during pumping, the shape at the surface depression resembled the surface deflection produced by a concentrated load on an elastic plate of infinite extent. — *from* Authors' abstract

08180 **'Peterson, R. A.** Remote sensing in layered rocks: Geocom Bull., v. 3, no. 9, p. 162-169, illus., 1970; reprinted from Bendix Tech. Jour., v. 3, no. 2, p. 1-8, 1970.

The great economic interest in remote sensing of the interior of layered rock bodies stems from the widespread occurrence of oil and gas in such environments. This paper describes briefly the nature of the geologic object field, the illumination of the field with seismic waves, the recording or remote sensing of returning reflected and diffracted waves, and the preparation of the data for final visual display. Both the hologram approach for monochromatic illumination and equivalent wave-mapping methods for broad-frequency-band illumination are illustrated. — Author's abstract

08331 **Péwé, Troy L.** Permafrost and vegetation on flood-plains of subarctic rivers (Alaska) — A summary [with French abs.] *in* Ecology of the subarctic regions, V. 1 *of* Ecology and conservation — A symposium, Helsinki, 1966, Proc.: Paris, UNESCO, p. 141-142, 1970.

Patterns and distribution of vegetation are distinctive in each phase of a flood plain of a major river in the subarctic due to drainage differences dictated by presence of and depth to top of the permafrost. The permafrost table gradually rises in younger to older flood-plain phases because mosses become thicker and provide better insulation. Four phases are recognized on major flood plains: Linear, or youngest, phase has linear lakes parallel to the river, no drainage integration, large deciduous trees, and permafrost is absent or low; advanced linear phase has distinct linear lakes, large coniferous trees, and a higher permafrost table; coalescent phase has coalescing linear lakes at an angle to the river, coniferous trees, some tundra, and a high permafrost table; scalloped phase has irregularly-shaped lakes with scalloped borders, integrated drainage, stunted coniferous trees, much tundra, a very high permafrost table, and much ground ice. — *from* Author's abstract

Phillips, R. Lawrence. *See* Clifton, H. Edward. 00622

Pinkham, C. W. *See* Moran, D. F. 00635

Pinson, W. H. *See* McCorkell, R. H. 08210

Pinson, W. H. *See* McCorkell, R. H. 08214

08352 **Piotrowski, J. M.; Edgar, A. D.** Melting relations of undersaturated alkaline rocks from south Greenland, compared to those of Africa and Canada: Medd. Grönland, v. 181, no. 9, 62 p., illus., tables, 1970.

Sixteen volcanic and plutonic undersaturated alkaline rocks of diverse composition were examined petrographically and their melting relations determined at 1 atm pressure in air; four samples were melted in an argon environment and six at water vapor pressures up to 2,070 bars. At 1 atm, liquidus temperatures range from 1,120°-1,230°C; water vapor pressures lower these temperatures by up to 300°C. For the majority of samples the sequence of crystallization is nepheline, feldspar and pyroxene at 1 atm, a sequence altered for some rocks by Ar atmosphere and water vapor pressure. There is a direct relation between melting intervals and chemistry of the rocks. Rocks showing agpaitic trends and high volatile content have longer melting intervals. — *from* Authors' abstract

Pittman, Edward D. *See* Lumsden, David N. 00864

Platonov, A. N. *See* Povarennykh, A. S. 08295

Ploessel, M. R. *See* Gorsline, D. S. 00743

08203 **Pluhar, Agnes; Ford, Derek C.** Dolomite karren of the Niagara Escarpment, Ontario, Canada [with German and French summaries]: Zeitschr. Geomorphologie, v. 14, no. 4, p. 392-410, illus., tables, 1970.

These solution landforms are abundant on the Middle Silurian dolomite paving the crest of Niagara Escarpment in Ontario. Most karren, initiated by release of glacier pressure, are guided by fractures in well-bedded, medium- or fine-grained rock, or developed in patches of favorable composition. *Cleft karren* follow straight joints for many meters, their planar walls tapering down through many beds. *Trench karren* or

smaller *pit-and-tunnel* types are sinuous, with flat floors on bedding planes. *Groove karren*, small shallow rounded features, are abundant in the more soluble zones, bounded by stylolite seams made less porous by tightest crystal packing; porosity variations of as little as 1 percent may create strong groove karren. *Split karren*, enlargements of very small discontinuous fractures normal to stylolite seams, taper sharply downward from dolomite surfaces between clefts and trenches. *Runnels*, sinuous streamlet cuts, are rare. — GDC

00896 **Podosek, F. A.; Huneke, J. C.; Burnett, D. S.; Wasserburg, G. J.** Isotopic composition of xenon and krypton in the lunar soil and in the solar wind: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 199-216, illus., tables, 1971.

Xe and Kr analyses of lunar samples and Murray meteorite, and Xe from terrestrial atmosphere are presented. Isotopic compositions of surface-correlated (solar wind,) and lunar soil spallation Xe and Kr are derived from lunar soil data alone. Lunar soil spallation Xe is similar to that in lunar rocks and meteorites, but Kr has higher Kr-84/Kr-83 and Kr-82/Kr-83 ratios. Surface-correlated Xe (SUCOR) is distinct from both AVCC and terrestrial Xe; SUCOR Xe cannot be directly identified with the solar wind, but may contain an admixture of gases from lunar atmosphere implanted on grain surfaces by ion pumping. The general fractionation trend in SUCOR Xe relative to the atmosphere presumably reflects solar wind composition. SUCOR Kr appears totally ascribable to solar wind. Solar wind and terrestrial Kr are related by fractionation, but opposite to that of Xe. — *from* Authors' abstract

00804 **Poland, J. F.** Status of present knowledge and needs for additional research on compaction of aquifer systems [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 11-21, illus., table [1971].

Deposits that are compacting in areas of major subsidence are relatively unconsolidated, chiefly alluvial and lacustrine sediments of late Cenozoic age, in confined aquifer systems of heterogeneous texture. Parameters needed to predict compaction include compressibility initial stress and change in stress, number and thickness of compressible beds, and vertical hydraulic conductivity. Methods for estimating compaction involve computing it from test results on cores, or deriving parameters for an entire aquifer system from field stress-strain relations. Methods to measure compaction (or expansion) of sediments include depth-bench-marks and counterweighted-cable or free-pipe extensometers, periodic casing-collar logging, and periodic measurement of emplaced radioactive bullets. Additional research is needed on the effect of multi-cyclic loading, methods for determining compressibility of aquifer systems and measuring compaction and pore pressures, estimating preconsolidation loads, and models capable of simulating compaction of confined systems. — *from* Author's abstract

00809 **Poland, J. F.** Land subsidence and aquifer-system compaction, Santa Clara Valley, California, U.S.A. [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 285-294, illus., table [1971].

Intensive withdrawal of ground water from the confined aquifer system, 800 feet (240 m) thick, in the San Jose area of Santa Clara Valley, California, has drawn down the artesian head as much as 150 feet (75 m) since 1912. Resulting land subsidence, which began about 1915, was 12.7 feet (3.9 m) in 1967. Periodic releveling of bench marks, core-hole data, and continuous measurements of water-level change and aquifer-system compaction have furnished quantitative evidence on the response of the system to cnange in applied stress. The adjusted subsidence-head decline ratio in San Jose for 1920-38 was about 1:10; this ratio can be utilized to estimate ultimate subsidence from subsequent head declines. Compaction records at some sites define the magnitude of excess pore pressures in aquitards; at one site, increasing artesian head by 46 feet (14 m) should stop the subsidence. — Author's abstract

Poland, J. F. *See* Schumann, H. H. 00810

00737 **Porath, H.** Magnetic variation anomalies and seismic low-velocity zone in the western United States: Jour. Geophys. Research, v. 76, no. 11, p. 2643-2648, illus., 1971.

Two-dimensional conductivity models relating the seismic low-velocity zone in the upper mantle to a zone of enhanced electrical conductivity satisfy the observed anomalous magnetic variation fields in the western United States. The upper mantle structure of the Colorado Plateau is intermediate between that of the Basin and Range and Southern Rockies provinces, characterized be a well-developed low-velocity zone and high electrical conductivity, and the structure of the Great Plains, where mantle conductivities are low and the low-velocity layer is thin. — Author's abstract

00926 **Porter, Stephen C.** Holocene eruptions of Mauna Kea volcano, Hawaii: Science, v. 172, no. 3981, p. 375-377, illus., table, 1971.

Postglacial lava flows, interstratified with thick locally derived sheets of tephra, cover some 27.5 sq km on the south slope of Mauna Kea. Most of the volcanics were erupted about 4500 years ago and overlie a regionally extensive paleosol which developed largely during the last glaciation. — Author's abstract

Potter, Paul Edwin. *See* Hrabar, S. V. 00928

08295 **Povarennykh, A. S.; Platonov, A. N.; Belichenko, V. P.** On the colour of ussingite from the Ilímaussaq (South Greenland) and Lovozero (Kola Peninsula) alkaline intrusions (Contribution to the mineralogy of Ilimaussaq No. 19): Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 20-26, illus., table, 1970.

Ussingite, $Na_2[AlSi_3O_8]OH$, is a pale violet mineral displaying a distinct thermoluminescence. The spectral absorption curves of the visible region, the thermoluminescence, and the electronic paramagnetic resonance of two specimens of ussingite from the Ilímaussaq alkaline massif (South Greenland) and from Lovozero (the Kola Peninsula) have been investigated. It is suggested that the natural and artificial (produced by X-ray irradiation) violet color of ussingite is connected with radiation centers $(SO_4)^-$, which are typical for the feldspathoids. — Authors' abstract

Preston, H. *See* Donnay, Gabrielle. 00953

00844 **Price, Larry W.; Alexander, Charles S.** Methods of measuring mass wasting — Review and critique: Assoc. Am. Geographers Proc., v. 3, p. 135-139, 1971.

The use of more precise and better controlled methods of measuring mass wasting is stressed. *In situ* rocks, small pins, dowels, and cone targets are better devices for measuring surface movements than are wooden stakes. Methods for monitoring movement with depth include: the Young pit, vertical velocity column, mass wasting meter, radioactive devices, and strain gauges, of which the latter two show the greatest promise. The value and significance of field measurements in geomorphology is limited by the techniques used. — Authors' abstract

00821 **Prokopovich, N.** Prediction of future subsidence along Delta-Mendota and San Luis Canals, western San Joaquin Valley, California [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 600-610, illus. [1971].

From 1905 to 1951 piezometric ground-water levels along the Delta-Mendota Canal declined up to 200 feet. Canal deliveries stopped the overdraft but continuing readjustment of pore pressures caused continuing "residual subsidence" at diminishing rates. Subsidence affected the downstream 35-40 mi of the canal from 1953-1966, locally exceeding 6 feet. Estimates of ultimate future subsidence varying from traces to 3.6 feet were derived from bench mark data treated as an exponential decay function. About 80 mi of the San Luis Canal are subsiding. From 1905-1962 piezometric levels declined up to 470 feet causing up to 18 feet of subsidence. Ultimate subsidence after 1963 is estimated as from traces to 15.2 feet (based on subsidence rates) or 10.4 feet (based on piezometric decline-subsidence ratios). Hydrocompaction of low-density sediments above the water table occurs in two parts of the canal possibly due to freezing-swelling and freeze-drying of Pleistocene mudflows. — *from* Author's abstract

08297 **Pruitt, W. O., Jr.** Some ecological aspects of snow [with French abs.] *in* Ecology of the subarctic regions, V. 1 *of* Ecology and conservation — A symposium, Helsinki, 1966, Proc.: Paris, UNESCO, p. 83-99, illus., tables, 1970.

The author studies the snow cover of the interior of Alaska which is the same type of snow as that in taiga regions and which has not been altered by the heat or humidity of the subsoil. The snow of the taiga is a liaison agent (ecotone) between very differentiated milieus. Tundra snow is displaced and altered by the wind. Effects of wind on the snow and the chronological development of faunal associations in relation to the snow are discussed. — EH

Quinn, W. J. *See* Hanrahan, E. T. 08253

Radforth, N. W. *See* Korpijaakko, E. O. 08246

Radforth, N. W. *See* MacFarlane, I. C. 08248

08313 **Radforth, N. W.** New developments in peatland studies, *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 1-3, 1970.

The author emphasizes the interdisciplinary nature of contributions to muskeg or peatland exploitation and mentions achievements in peat research and in associated fields such as soil science, botany, agriculture, hydrology and mining which have made contributions. Technological research led to development of peatlands for agriculture and forests, of special roads and vehicles for muskeg terrain, and of other engineering aspects of such terrain. Definition and classification of muskeg was basic to peat studies. Future problems include pollution (effect of peat on conserving water supply), population explosion (effect of transporting peat to improve arid lands and agricultural development of unproductive muskeg), and mechanism (increasing productivity of forested muskeg). National committees, interdisciplinary in composition, should be set up to deal with conservation, productivity, and utilization of peat resources. Twelve primary research problems are listed. — EH

Ragland, Paul C. *See* Weigand, Peter W. 08275

08141 **Rampton, Vern.** Neoglacial fluctuations of the Natazhat and Klutlan Glaciers, Yukon Territory, Canada: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1236-1263, illus., table, 1970.

These glaciers are surging valley glaciers. Both have massive, ice-cored Neoglacial morainal complexes extending down-valley from the termini. At least six separate Neoglacial moraines adjacent to Klutlan and four adjacent to Natazhat have been identified. Most are less than 550 years old, although both glaciers have been relatively inactive near their termini since 1947. Stratigraphy and C-14 dates suggest that the initial Neoglacial advance of Natazhat occurred about 3300 B.P. and that of Klutlan about 1520 B.P. Intervals during which the glaciers constructed a number of moraines near their Neoglacial maxima probably were caused by cool summer temperatures, even though individual moraines were formed by glacial surges. A number of factors make impossible precise dating of the intervals of cool summer temperatures. — *from* Author's abstract

08386 **Randolph, Jennings.** Sediment, number one water pollutant — Keynote address *in* National Conference on Sediment Control, Washington, D.C., 1969, Proc: Washington, D.C., U.S. Dept. Housing and Urban Development Environmental Planning Division, p. 1-7, 1970.

In concern with more toxic materials, sediment has not been considered the number one water pollutant; but subtly, large shifts in our nation's top layer of earth — billions of tons each year — create havoc in agricultural industry, water supplies, reservoirs, stream channels, and urban areas. Damage caused by this misplaced soil far outweighs benefits; most noticeable are natural disasters, but greatest changes are taking place gradually. At least half the sediment comes from agricultural lands, 5 and 10 percent from burnt forest and rangelands, and locally large amounts from

mining areas and construction sites. Clogging of streams and ditches seriously impairs their drainage ability, silted dams reduce water storage in reservoirs, silted waterways require costly dredging. Steps taken to halt erosion, protect stream and road banks, refill and reforest scarred lands, so far feeble, do indicate increasing concern. — GDC

08296 **Rapp, A.** Some geomorphological processes in cold climates [with French abs.] *in* Ecology of the subarctic regions, V. 1 *of* Ecology and conservation — A symposium, Helsinki, 1966, Proc.: Paris, UNESCO, p. 105-114, illus., 1970.

The distribution of frost-controlled landforms in the subarctic region and the processes of frost-heaving, solifluction, creep, and formation and decay of permafrost are described. Most observations of these forms and processes have been made from about 1920-1950 during a shift toward warmer climate. A cooling climate since that time, if it continues, may increase the activity of these frost processes and extend permafrost features in the subarctic. — EH

Rasmussen, Lowell A. *See* Campbell, William J. 08213

Rasmussen, Lowell A. *See* Campbell, William J. 08217

08325 **Ratcliffe, Nicholas M.** Ancient strike-slip fault tectonics in the Hudson Highlands and Manhattan Prong: New York Acad. Sci. Trans., ser. 2, v. 32, no. 8, p. 1009-1021, illus., 1970.

Intermittent strike-slip movement on the Ramapo fault system since late Precambrian and intrusive relations of igneous rocks of late Precambrian to Silurian or Devonian suggest that this fracture zone is basement-controlled. Fault movement and igneous activity in pre-Middle Ordovician suggest that the northern Reading Prong in New York and Connecticut is not allochthonous. The Hudson Highlands behaved as deep-seated basement in which steep strike-slip fault tectonics were important in middle Paleozoic. Right-lateral strike-slip faulting along Canopus Valley in post-Middle Ordovician — pre-Devonian time caused intense refolding of Taconian folds in Manhattan Prong south of the Highlands, and was accompanied by emplacement of mafic igneous rocks. Extent of movement on the Ramapo fault could be great. [The significance of its relation to the Triassic Newark Basin is examined.] — *from* Author's summary

08374 **Rau, Weldon W.** Foraminifera, stratigraphy, and paleoecology of the Quinault Formation, Point Grenville-Raft River coastal area, Washington: Washington Div. Mines and Geology Bull. 62, 41 p., illus., 1970.

One new species and 56 additional species of Foraminifera from the Quinault Formation are illustrated and their significance discussed. Assemblages were collected from 101 localities in four measured sections and in isolated outcrops along the coast. Total stratigraphic thickness may be 6,200 feet. Locally the Quinault represents an upper part of the upper Tertiary-lower Quaternary sequence. Stratigraphic distribution of Foraminifera in the Quinault indicates that the formation may represent an interval in filling of its basin of deposition similar to intervals represented by other formations in young basins along the coast. Environmental conditions of deposition in the measured sections are varied, as revealed by foraminiferal assemblages. — *from* Author's abstract

Ravina, Israela. *See* Low, Philip F. 00940

08244 **Raymond, G. P.** Construction method and performance of an embankment on a deep muskeg [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 51-56, illus., table, 1970.

The design, construction and performance of a surcharged highway embankment across a virgin muskeg deposit is described. Using theoretical soil mechanics concepts it was predicted that the long-term stability of the peat plus lake marl layers

necessitated the use of berms despite the fact that an undrained strength analysis based on in situ vane tests predicted a reasonable factor of safety. This fact is supported by the performance of an existing road. Consideration of both theoretical soil mechanics concepts and practical considerations suggested that berm construction should be from the outer limits towards the centre and should be placed prior to the central fill. The central fill was to be placed in thickness rather than grades and was to be placed in stages. Eighteen piezometers, 12 settlement tips placed at various depths, and 24 surface settlement plates were used to control the construction and measure the performance of the muskeg. — Author's abstract

Raymond, W. H. *See* King, R. U. 00684

Reed, John C., Jr. *See* Southwick, D. L. 00936

Reed, John C., Jr. *See* Bryant, Bruce. 08176

00656 **Reed, Lloyd A.** Hydrology and sedimentation of Corey Creek and Elk Run basins, north-central Pennsylvania: U.S. Geol. Survey Water-Supply Paper 1532-E, p. E1-E27, illus., tables, 1971.

Analysis of data collected from two small agricultural basins in north-central Pennsylvania during the period May 1954-September 1967 indicates that conservation measures reduced the quantity of suspended sediment leaving the Corey Creek basin as a result of frequent storms during the growing season. Extensive soil conservation treatments were applied in the 12.2-sq-mi Corey Creek basin, but only minor treatments were applied in the adjacent 10.2-sq-mi Elk Run basin. Trend analyses of data from both basins indicate a 47-percent decrease in sediment discharge from Corey Creek during storms in the May-October growing season. — *from* Author's abstract

08396 **Rees, John D.** Paricutin revisited — A review of man's attempts to adapt to ecological changes resulting from volcanic catastrophe [with French and German summaries]: Geoforum 4, p. 7-25, illus., tables, 1970.

During nine years of activity, the Paricutin volcano devastated forest and crop lands. Lava flow and ashfall forced thousands of Itzicuaro Valley inhabitants to migrate. To restore an ecologically valuable landscape, four zones representing the effects of volcanism on vegetation are recognized. Land use data on each of these zones were mapped and tabulated from pre-eruption photos. The success or failure of individual species is correlated to ash depth, site characteristics, and other factors. Post-eruption crop cultivation is dependent upon (1) removal of ash mantle, or (2) enrichment of infertile ash. The Upper Itzicuaro Valley is not yet recovered from the Paricutin eruption. — Author's abstract

Reeves, C. C., Jr. *See* Brand, John P. 00798

Reitan, Paul H. *See* Szekely, J. 00670

00836 **Renfro, Graham W.** Sediment measurement techniques — [Pt.] C, Accelerated valley deposits — Discussion [of paper 7269 by Am. Soc. Civil Engineers (Task Comm. on Preparation of Sedimentation Manual), 1970]: Am. Soc. Civil Engineers Proc., v. 97, Jour. Hydraulics Div., no. HY3, p. 460-461, 1971.

The valley sediment measurement methods set forth in paper 7269 (ibid., v. 96, no. HY5, p. 1157-1166, 1970; *see* Abs. North American Geology, November 1970) were developed by the U.S. Soil Conservation Service. Watershed sediment is considered an integral part of the overall flood problem. A major sediment damage in small watersheds is that caused by deposition on agricultural land, resulting in swamping. Sedimentation damages in the United States are particularly severe in subprovinces such as interior West Cross Timbers, Redbeds Plains, Loess Hills and Loess Bluff areas; and Southern Piedmont and Southern Coastal Plain portions of several southeastern states. Brief descriptions are contained in the watershed work plans filed by S.C.S. — GDC

Renton, John J. *See* Hidalgo, Robert V. 08393

08382 **Revelle, R.; Seibold, E.; Uyeda, S.; Udintsev, G.; Gierman, G.; Peres, J.** Problemy morskoy geologii v svyazi s ispol'zovaniyem mineral'nykh resursov Zemli [Problems of marine geology in connection with utilization of the mineral resources of the Earth (with English summ.)]: Okeanologiya, v. 10, no. 6, p. 931-946, 1970.

This paper, originally entitled "Dynamics of the Ocean Floor," sets forth the geological and geophysical part of the long-term expanded program of Global Ocean Research, proposed as a result of the meeting of the Joint Working Group of the Advisory Committee on Marine Resources Research, the Scientific Committee on Ocean Research, and the World Meteorological Organization, in Ponza, Italy, on April 28 to May 4 and in Rome on May 6 and 7, 1969. — DBV

00719 **Reynolds, Mitchell W.** Geologic map of the Bairoil quadrangle, Sweetwater and Carbon Counties, Wyoming: U.S. Geol. Survey Geol. Quad. Map GQ-913, scale 1:24,000, sections, 1971.

00792 **Rhoads, Donald C.; Cande, Steven.** Sediment profile camera for *in situ* study of organism-sediment relations: Limnology and Oceanography, v. 16, no. 1, p. 110-114, illus., 1971.

An instrument is described that will take high resolution photographs of silt-clay bottom types in profile. The bottom (10-20 cm) is penetrated by a slowly descending ($\leq$ 7 cm/sec) wedge-shaped Plexiglas chamber, and the sediment profile that is cut is photographed. Such photographs reveal *in situ* details of bottom topography, sediment texture, depth of bioturbation, biogenic structures, and living positions of mud-dwelling benthos. The instrument can be modified to take closeup vertical photographs of the bottom and to obtain undisturbed core samples. — Authors' abstract

Ribbe, P. H. *See* LeRoux, J. 08418

Rich, C. I. *See* LeRoux, J. 08418

00852 **Rich, Mark.** Middle Pennsylvanian rocks of eastern Great Basin: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 432-453, illus., tables, 1971.

Atokan and Desmoinesian rocks in this region consist mostly of nine carbonate rock types, but include orthoquartzites, prominent to the east. Main lithofacies correspond closely to lithostratigraphic unit distribution: (1) upper Ely Group, relatively deep-water basin assemblage, (2) Bird Spring Group and Callville Limestone, transitional between shallow shelf and basin, (3) Oquirrh Formation, a transitional "slope" assemblage. Paleogeographic reconstruction visualizes an expansion of basinal environment after the Atokan with alteration of orthoquartzite and calcareous sediments in the area of Oquirrh Formation. A sedimentary model and interpretation of cyclic sedimentation are presented. — EGS

08190 **Richards, Horace G.; Fairbridge, Rhodes W.** Annotated bibliography of Quaternary shorelines, 1965-1969 — Prepared for 8th Internat. Cong. INQUA, 1969; supp. to that prepared for 7th Internat. Cong. INQUA, 1965: Acad. Nat. Sci. Philadelphia Spec. Pub. 10, 240 p., 1970.

The supplement contains slightly over 1,800 abstracts a few of which are pre-1965 that did not get in the earlier volume. The abstracts are divided by countries; the first section covering general articles. — ESL

08138 **Richards, T.; White, William H.** K-Ar ages of plutonic rocks between Hope, British Columbia, and the 49th parallel: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1203-1207, illus., tables, 1970.

Twenty-two new K-Ar age determinations are reported for the plutonic rocks between Hope, B. C. and the 49th parallel. Ages ranging from 103 m.y. to 16 m.y. suggest an extension in southern British Columbia of Mesozoic plutonism into Late Cretaceous time and three brief and well-defined Tertiary plutonic events. — Authors' abstract

Rickards, R. B. *See* Bulman, O. M. B. 08179

Ridley, W. I. *See* Baker, I. 08272

Rieck, H. G. *See* Silker, W. B. 00859

00815 **Riley, Francis S.** Analysis of borehole extensometer data from central California [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 423-431, illus., table [1971].

In subsiding areas of central California, highly sensitive borehole extensometers provide data that define the compression characteristics of the compacting artesian aquifer systems. The extensometer records are combined with hydrographs for the confined and unconfined aquifers to form stress-strain diagrams on which the annual cycles of head decline and recovery generate a series of open loops. Gross compaction, elastic expansion, and net permanent compaction are clearly defined. The average level of preconsolidation stress, the elastic compressibility at lesser stresses, and the much larger plastic compressibility at higher stresses can often be determined from such diagrams. At a given location, these compressibilities may differ by as much as two orders of magnitude. Under favorable circumstances, estimates of the average vertical permeability and average compressibility of the fine-grained strata can be derived. — Author's abstract

08236 **Rinker, Jack N.; Frost, Robert E.** Application of remote sensing to Arctic environmental studies, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 105-116, illus., [1970].

Remote-sensing and techniques of analysis of aerial imagery can help to solve engineering problems in arctic and subarctic environments, especially those related to permafrost, severe frost activity, and thermal upset induced by disturbance. The effects of permafrost and severe frost on engineering design are a known factor. Various remote-sensing techniques can be used to some extent to study and evaluate problems of the frost/permafrost environment. Conventional photography is still a most useful tool and photointerpretation still of great importance in environmental analysis. The author cites a need for an interdisciplinary analysis team approach for area analysis, consisting of the combined capabilities of man, conventional and remote-sensing imagery, and computers. — EH

00812 **Roberts, James E.** Sand compression as a factor in oil field subsidence [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 368-376, illus., table [1971].

The results of a comprehensive experimental investigation of the compressibility of clastic sediments at high pressures are summarized. Of particular importance was the discovery that, in the pressure range of 1,000 to 20,000 psi, certain sands may be at least as compressible, if not more compressible, than typical clays. This high compressibility, which is due to a shattering of individual grains, indicates that a stratum of oil-bearing sand which is subjected to effective stress changes in the same pressure range may contribute significantly to the surface subsidence. The relative importance of clay and sand compression as contributory to subsidence and the conditions under which either or both is important are summarized. It is concluded that even at a depth of 3,000 feet compression of oil-bearing sands may contribute significantly to subsidence. — Author's abstract

08136 **Roberts, M. C.; Mark, D. M.** The use of trend surfaces in till fabric analysis: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1179-1184, illus., 1970.

A method, based on trend surface analysis, was developed to utilize till fabric data in the construction of ice movement maps. To illustrate the technique three areas were selected: the Wadena drumlin field of Minnesota, the till plain of East Anglia, and the Fraser Valley area of British Columbia. — Authors' abstract

08162 **Robertson, D. S.** Uranium — Its geological occurrence as a guide to exploration, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna,

1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 267-284, incl. discussion, illus., tables, 1970.

Uranium is a lithophile element and is concentrated by processes active in the crust. About 90 percent of the world's reserves occur in basal Huronian conglomerates and post-Paleozoic sandstones. Expansion of reserves under current economic conditions requires finding of further reserves of these types. Ore deposits in basal Huronian are of detrital origin. They are restricted in time to a period after development of extensive acid crust but before evolution of an oxidizing atmosphere, and thus are of extremely restricted occurrence. Post-Paleozoic sandstone ore deposits, called Western States type, are formed by leaching of uranium from granite surfaces, volcanic sediments or arkoses, the movement of uranium in ground water, and its precipitation by organic material. It appears that necessary processes take place only in arid to semi-arid climates, so that areas of the Earth in which such deposits can be found are limited. — *from* Author's abstract

00971 **Robertson, J. A.** (compiler). Blind River-Elliot Lake sheet, Districts of Algoma and Sudbury: Ontario Dept. Mines and Northern Affairs Preliminary Map P.304 (1971 revision), geol. Compilation Ser., scale 1 in to 2 mi, 1971.

00706 **Robertson, James A.** Contemporaneous faulting and clastic intrusion in the Quirke Lake Group, Elliot Lake, Ontario — Discussion [of paper by G. H. Eisbacher, 1970]: Canadian Jour. Earth Sci., v. 8, no. 2, p. 307-308, 1971.

The paper under discussion was published in ibid., v. 7, no. 2, p. 215-225, 1970; Abs. North American Geology, September 1971.

Robeson, D. W. *See* Ayres, L. D. 00870

Robeson, D. W. *See* Ayres, L. D. 00871

Robeson, D. W. *See* Ayres, L. D. 00872

Robeson, D. W. *See* Ayres, L. D. 00873

08212 **Robin, G. de Q.** Stability of ice sheets as deduced from deep temperature gradients, *in* Internat. Symposium on Antarctic Glaciological Exploration (ISAGE), Hanover, N.H., 1968 [Proc.]: Internat. Assoc. Sci. Hydrology (and Sci. Comm. Antarctic Research) Pub. 86, p. 141-151, illus., tables, 1970.

Analyses of deep temperature profiles provide a powerful means of examining stability and past history of ice sheets. Although some estimates can only be approximate, the method has two great advantages over equating total accumulation against mass outflow over a strain network. In the temperature analysis an error in accumulation is reproduced as a proportional error in the effective mass balance. In the mass budget case, dependent on arithmetical difference between two figures, an error in A or in estimating mass outflow can produce large errors in the final mass difference providing the answer. The temperature analysis produces an answer for mean conditions over periods of 1000 years, compared with one covering the period of survey only for mass budget methods. The way to obtain much of this temperature data appears to exist in the Philberth type probe. — *from* Author's abstract

08419 **Robinson, A. R.** Technology for sediment control in urban areas, *in* National Conference on Sediment Control, Washington, D.C., 1969, Proc: Washington, D.C., U.S. Dept. Housing and Urban Development Environmental Planning Division, p. 48-54, 1970.

Sediment yield from an area under development may be several hundred that form a stable agricultural area. Techniques for lessening sediment yield and delivery developed for the agricultural land can generally be applied to the urban area. Research on sedimentation and erosion has lagged behind needs; to date there is only limited knowledge of basic processes and forces involved in detachment, entrainment, transportation, and final disposition of sediment and on mechanics of soil stability. Much of the technical knowledge now available for controlling erosion and runoff on farm and rural lands does apply to urban areas; the Soil Conservation and Forest Services can give valuable assistance. — GDC

00710 **Rockie, William A.** Soil conservation, Chap. 5 *in* Conservation of Natural Resources (Guy-Harold Smith, editor): New York, John Wiley and Sons, p. 99-132, illus., 1971.

Soil erosion has been an enemy of civilization since land use began; other damage includes excessive salinity and alkalinity, lowered fertility, inadequate drainage or aeration, and loss of soil structure. Innumerable farming methods and practices reflect variations in soil conditions and people. The United States government recognized the problem in 1903 with field studies in "hillside erosion," and created the Soil Conservation Service in 1935, within the Department of Agriculture. This resulted in widespread cooperation of farmers and much better conservation practices. Various types of erosion, and principles of effective control and application of conservation measures to various kinds of land are reviewed. The most common of 124 approved practices and objectives of some special multipurpose watershed projects are described. — GDC

Rodriguez Ortiz, Jose M. *See* Jimenez Salas, Jose A. 08337

08276 **Roeder, P. L.; Emslie, R. F.** Olivine-liquid equilibrium: Contr. Mineralogy and Petrology, v. 29, no. 4, p. 275-289, illus., tables, 1970.

Experiments with several basaltic compositions from 1150 to 1300°C and oxygen fugacity ($10^{-0.68}$-10^{-12} atm) af one atm pressure permit several empirical equations to relate the olivine composition to the liquid. The distribution coefficient, given here, relates partitioning of Fe and Mg between olivine and liquid and is independent of temperature. The olivine composition can be used to determine the Mg to ferrous Fe ratio of the liquid from which it crystallized. — *from* Authors' abstract

00946 **Rollins, Harold B.; Eldredge, Niles; Spiller, Judith.** Gastropoda and Monoplacophora of the Solsville Member (Middle Devonian), Marcellus Formation) in the Chenango Valley, New York State: Am. Mus. Nat. History Bull., v. 144, art. 2, p. 129-170, illus., tables, 1971.

Recent collections from Solsville shales and calcareous siltstones have yielded large populations of mollusks, some with well-preserved ornament or recognizable shell microstructure; thus, ontogeny and phylogeny can be analyzed for many Hamilton Group species that were previously known only from distorted, poorly preserved specimens. Described herein are 20 species, in 16 genera, of Archaeogastropoda; the caenogastropod *Palaeozygopleura hamiltoniae*; and the cyclomyan monoplacophoran *Cyrtonella mitella*. The arachaeogastropod fauna consists of: 6 species of bellerophontaceans, including *Praematuratropis ovatus*, n.gen., n.sp., distinguished by ovoid shape, conspicuous keel, and extensive inductura; 5 pleurotomariaceans (2

new); 6 placyceraceans; 2 murchisoniaceans; one neritacean. Origin of Phymatopleuridae from Eotomariidae is discussed in light of ontogenic changes in some pleurotomariacean species. — VMJ

Rollo, J. R. *See* Davis, G. H. 00807

Ronca, Luciano B. *See* Horz, Friedrich. 00674

08278 **Rondot, Jehan.** La structure de Charlevoix comparee à d'autres impacts météoritiques [The Charlevoix structure compared with other meteoritic impacts (with English abs.)]: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1194-1202, illus., table, 1970.

Most of the circular structures considered as meteorite impacts have a central uplift and a well-developed annular depression. A graph of vertical stratigraphic displacement of the central uplift and depression as a function of depression diameter indicates linear relations. However, vertical displacement is not exactly proportional to the diameter. The vertical displacement of the depression is about 1/40 the diameter for smaller structures and about 1/30 the diameter for larger structures. — Author's abstract

Ronka, Vaino. *See* Paterson, Norman R. 00700

08319 **Rose, Arthur W.** Atlas of Pennsylvania's mineral resources — Pt. 3, Metal mines and occurrences in Pennsylvania: Pennsylvania Geol. Survey 4th ser., Bull. M50, pt. 3, 14 p., illus., tables, 1970.

The locations and basic characteristics of all known occurrences of arsenic, antimony, bismuth, chromium, cobalt, copper, gold, lead, molybdenum, nickel, silver, tungsten, uranium, and zinc, plus some data for iron, vanadium, cadmium, and barium are given for the state of Pennsylvania. Occurrences of iron, copper, lead, zinc, chromium, and uranium comprise the bulk of the localities. Data are presented in three forms: a table, listing all known occurrences with data on metals present, degree of exploitation, deposit type, and references; map showing location of occurrences keyed to the table; and a short description in the main text of each deposit type and its history, geology, and production. — VSN

00972 **Rose, William D.** Bibliography and index of Oklahoma Geology 1970: Oklahoma Geology Notes, v. 31, no. 2, p. 23-37, 1971.

This bibliography consists of 105 items on the geology of Oklahoma published in 1970 with a few from 1969. A subject index is included. — VSN

08423 **Rosholt, J. N.; Peterman, Z. E.; Bartel, A. J.** U-Th-Pb and Rb-Sr ages in granite reference sample from southwestern Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 1, p. 184-187, illus., tables, 1970.

Concordant total rock Pb-206 — U-238, Pb-207 — U-235, Pb-207 — Pb-206, Pb-208 — Th-232, and Sr-87 — Rb-87 ages of 1805 ± 40, 1815 ± 55, 1820 ± 110, 1790 ± 60, and 1810 ± 50, in millions of years, respectively, were obtained on the reference sample of biotite granite. The sample is a piece of drill core from a depth of 7300 feet (about 2225 m), about 80 feet (about 24.4 m) below the top of the Precambrian basement complex, in southwestern Saskatchewan. — Authors' abstract

Ross, D. C. *See* Dodge, F. C. W. 00827

08189 **Ross, David A.** Introduction to oceanography: New York, Appleton-Century-Crofts, Educ. Div., Meredith Corp., 384 p., illus., tables, 1970.

An attempt is made to describe and explain oceanography in a manner understandable to nonscientists; the book was written as a text for an introductory course. The term is defined as the application of all science to the study of the ocean, and the

author has tried to make clear the role of each scientific discipline and to show their interrelationships in the study of marine environment. Chapters include origin of the Earth, the ocean, and life; history of the science; instruments and techniques; chemical, biological, and physical oceanography; marine geology and geophysics; and resources of the ocean. A glossary of oceanographic terms is included. — ESL

00915 **Rothstein, Joe.** "Stevensite" — A review: Mineralog. Record, v. 2, no. 1, p. 30-31, illus., 1971.

In 1969, when the road bed for I-80 was being blasted out of basalt, in West Paterson, N.J., a mineral that appeared to be pink pectolite was found and was finally identified as "stevensite," first described in 1873 as a talc pseudomorph after pectolite. By 1900, "stevensite" was entrenched in the literature as a form of talc. In 1916, a new occurrence was described in New Jersey at the old Hartshorn quarry in Springfield Township; it probably was a result of reaction of pectolite with magnesium-rich solutions. In 1953 results of a new study indicated that "stevensite" is a member of the montmorillonite group. Further work by Brindley (1955) on "stevensite" from Springfield showed that it could be described as a talc-saponite interlayered mineral. In 1959, other authors concluded that stevensite was actually a montmorillonite clay mineral. — ESL

00858 **Rothwell, Gar W.** Additional observations on *Conostoma anglo-germanicum* and *C. oblongum* from the Lower Pennsylvanian of North America: Palaeontographica, ser. B, v. 131, nos. 5-6, p. 167-178, illus., 1971.

New specimens of lagenostomalean seeds found in coal balls below the Magoffin Limestone at the Lewis Creek locality, Leslie County, Ky., provide information for reinterpreting the structure and emending the diagnoses of two species of *Conostoma*; age of fossil plants at this locality is considered Early Pennsylvanian (Westphalian A equivalent). The original description of *C. anglo-germanicum* Oliver and Salisbury, 1911, from the Lower Coal Measures (Westphalian A) of Great Britain and Germany, constitutes the only detailed study to date. *C. oblongum* Williamson, 1877, from Lower Coal Measures of Great Britain, has been reported also from the Middle Pennsylvanian (Desmoinesian) of Illinois (Krick, 1932; Reed, 1939) and Iowa (Kern and Andrews, 1946). Structure and probable development of the pollen-receiving mechanism is compared with that of other lagenostomaleans, and phylogeny of the genus is reinterpreted. — VMJ

Roubal, R. K. *See* Horton, J. W. 00736

00969 **Rowett, Charles L.** Reconnaissance biostratigraphy of the lower Permian in the Slana area, eastern Alaska Range, Alaska: Pacific Geology, v. 3, p. 31-44, illus., 1971.

Reconnaissance of the Tetelna and Mankomen Formations near Slana, Alaska, permits their biostratigraphic correlation with the lower Permian sedimentary and volcano clastic sequence of rocks exposed in the headwaters region of the Delta River. Four coral zones are common to both areas and occur in the same stratigraphic sequence in both areas. These zones in ascending order, are the *Auloclisia deltense* zone, the *Timania* cf. *T. schmidti* zone, the *Sinopora minatoi* zone, and the *Durhamina alaskaensis* zone. Biostratigraphic correlation of these zones indicates that nearly 6,000 feet of subaerial volcanic lavas accumulated in the Slana area (Tetelna Formation) contemporaneously with fossiliferous marine volcanoclastics and limestones in the Delta River area. Subsidence began in the Slana area in the early Artinskian, followed by an eastward marine transgression. The resulting deposits (Mankomen Formation) incorporate the same biostratigraphic succession of rugose and tabulate corals. — *from* Author's abstract

08361 **Russell, Ernest E.; Wilson, Charles W., Jr.** Geologic map of the Big Sandy quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 20-NE, scale 1:24,000, separate text by A. T. Staller, 1970.

08130 **Russell, Loris S.** Correlation of the Upper Cretaceous Montana Group between southern Alberta and Montana: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1099-1108, illus., 1970.

The Lower Milk River sandstone of Alberta is the same as the lower Eagle sandstone of Montana, and both differ from the Virgelle. The Pakowki Formation of Alberta is the Clagget of Montana plus the lower Judith River Formation. The upper Judith River is equivalent to the Foremost and Oldman Formations of Alberta. The Bearpaw Formation thins to the west and the upper shales pass into marine sandstones and these into nonmarine formations. Of the various formational boundaries, the top of the lower Milk River and the lower Eagle sandstones, the base of the Pakowki and Claggett Shale, and the top of the Oldman and Judith River Formations, are also time boundaries throughout large parts of the region. — *from* Author's abstract

Ruthven, R. T. *See* Burford, R. O. 00615

00777 **Saini, G. R.** Chemical and physical properties of coastal alluvial soils of New Brunswick: Geoderma, v. 5, no. 2, p. 111-118, illus., tables, 1971.

Soils in the coastal alluvial area at the head of Bay of Fundy in New Brunswick, Canada, were characterized for their chemical and physical properties. A great variability in the electrical conductivity of the soil extract ($E.C._e$) was observed depending on the history of flooding. The correlation coefficient between $E.C._e$ and sodium adsorption ratio (S.A.R.) was +0.89 ($P < 0.01$), but the correlation between S.A.R. and exchangeable sodium percentage was only +0.36 ($P < 0.05$). Among the physical properties highly significant relationships were found between saturation percentage and fifteen atmosphere percentage ($\gamma = +0.86$) and moisture equivalent and silt plus clay ($\gamma = +0.87$). These soils are poorly drained and at places salt content is high. Many farmers use these problem soils for keeping livestock and dairy herds. Grain crops are possible after drainage and improvement of soil structure. — Author's abstract

00654 **Saleem, Z. A.; Jacob, C. E.** Optimal use of coupled leaky aquifers: Water Resources Research, v. 7, no. 2, p. 382-393, illus., tables, 1971.

Aquifers enclosed or confined by sediments that impede or retard vertical movement of water generally leak. A stochastic dynamic programing model for optimal operation of a composite system of two coupled leaky aquifers and a surface water subsystem is formulated and applied to the Roswell basin in New Mexico. Optimal operating policies for the coupled aquifers are influenced by values added to the basin by different crops, amounts of water in storage in the two aquifers, the discount factor, and mutual leakage of aquifers. Some factors tend to increase, whereas others decrease the operating policy. The resultant of all these factors determines the final operating decision. The magnitude and direction of leakage are determined by relative storages in the aquifers. Coupled aquifer systems should be considered for conjunctive use only. — *from* Authors' abstract

00813 **Sandhu, Ranbir S.; Wilson, Edward L.** Finite element analysis of land subsidence [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 393-400, illus. [1971].

Application of the finite element method to the problem of land subsidence is presented. The settlement of a land mass is viewed as an immediate or time dependent surface deformation caused by direct application of surface loads or by the loss of support associated with mining or withdrawal of pore fluids. Practically all cases involving static or quasi-static subsidence can be treated. The method permits consideration of complex geometrical configurations and arbitrary boundary conditions. Non-homogeneity, anisotropy, viscoelasticity and creep, temperature effects, residual stresses, and plastic behavior can be allowed for. The method is applicable to two or three dimensional deformation and thus takes into account horizontal as well as vertical movements. — Authors' abstract

08148 **Sangrey, D. A.** Evidence of glacial readvance over soft-layered sediments near Kingston, Ontario: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1331-1339, illus., table, 1970.

A study of the soils in four filled valleys has defined two distinctly different sequences. The upper soil at all sites is a soft, horizontally layered or varved clay. Underlying these soils are stiff, overconsolidated deposits which appear to have been layered or varved clay but are now highly faulted and distorted; their low water content, overconsolidation, and structural distortion indicate glacial overriding. Measurements of preconsolidation stresses of these lower deposits provide data for calculations of overriding ice thickness and surface elevation of the ice. A consistent pattern was found from analysis of four widely separated boreholes. Surficial landforms and topography support the conclusion that parts of the area were overridden by ice. Engineering soil mechanics tests not normally used in geological interpretation are an important part of this analysis. — Author's abstract

00725 **Sass, John H.** The Earth's heat and internal temperatures, Chap. 5 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 80-87, illus., tables, 1971.

A knowledge of surface heat flow and its variation is required for an understanding of deep-seated Earth processes. This variation of heat flow over the terrestrial surface and its implications for thermal models of the Earth are discussed. The mean heat flow from continents is essentially equal to that from oceans. This near equality, in spite of the difference in underlying rocks implies a fundamental difference between mantles underlying these major units. Almost all radioactive heat is produced by isotopes of uranium, thorium, and potassium, and these must be more concentrated in the oceanic mantle than in the continental. Thermal models for the crust and upper mantle are described, as well as those for the whole Earth; several generalizations regarding the geotherm are made. — ESL

Saul, R. B. *See* Kahle, J. E. 00744

00745 **Saul, R. B.** Effects of the San Fernando earthquake in the Oat Mountain quadrangle: California Geology, v. 24, nos. 4-5, p. 83, illus., 1971.

A segment of the Santa Susana thrust fault trends due east across the southeast quarter of this quadrangle. Observations of the effect of the San Fernando earthquake indicate that east of Bee Canyon tectonic and/or lurching motion locally was coincident with or closely parallel to the sole of this thrust zone; this may represent a local deflection of energy along existing planes of weakness. — VSN

Savage, J. C. *See* Burford, R. O. 00615

Sayre, William M. *See* Yang, Chih Ted. 00906

Schaudy, Rudolf. *See* Wasson, John T. 00781

08332 **Schenk, E.** Permafrost and frost structures in the subarctic area [with French abs.] *in* Ecology of the subarctic regions, V. 1 *of* Ecology and conservation — A symposium, Helsinki, 1966, Proc.: Paris, UNESCO, p. 155-159, tables, 1970.

When soil freezes, water molecules which surround soil particles in form of a film of absorption water and osmotic water are consumed by ice crystals. A difference in osmotic pressure is produced in the film which trips movement of water toward the freezing point. The soil shrinks as much as 20 percent of its volume due to consumption of its water and a polygonal network of fissures and fractures is formed. These new freezing surfaces control movement of water and growth of frost crystals topped by soil particles torn from fissure walls. Air is imprisoned between ice crystals during their growth, and ice and ice wedges are characterized by soil particles and air bubbles. Ice lenses of patterned soils, polygons, mounds (palsas and pingos) and patterned peat bogs (aapamoors) are all a result of these processes. — *from* Author's abstract

Schieltz, N. C. *See* Jansen, G. J. 00912

08312 **Schmucker, Ulrich.** Anomalies of geomagnetic variations in the southwestern United States: California Univ. Scripps Inst. Oceanography Bull., v. 13, 165 p., illus., tables, 1970.

Large Z-variations along the California coast, which disappear inland within 200 km, are interpreted as an 'edge effect' of oceanic induction currents and suggest relatively high internal conductivities under this coast. Less prominent anomalies of vast variations further inland in California and Nevada are partly explainable by superficial conductivity contrasts, but there is clear indication of local uplift of highly conductive mantle material along the eastern slope of the Sierra Nevada near Napa. Observations from Tucson, Ariz., to Sweetwater, Tex., indicate a general increase of mantle conductivity under southern Arizona and a zone of high conductivity under the Rio Grande Rift Belt. The mantle under southern Arizona and the California coast is three times more conductive than that under West Texas, possibly due to lateral temperature increase of 100°C from east to west, in conformity with changes of heat flow. — VSN

08356 **Schneider, E. D.; Johnson, G. L.** Deep ocean diapiric structures [with French and German abs.], *in* The Geology of the East Atlantic Continental Margin — ICSU/SCOR Working Party 31 Symposium, Cambridge, England, 1970, [Pt.] 1, General and Economic Papers: [Great Britain] Inst. Geol. Sci. Rept., no. 70-13, p. 153-175, illus., 1970.

Diapiric structures from various oceanic environments are reviewed with emphasis on paleo-conditions responsible for both their formation and areal extent. Pseudodiapirs are a common feature of oceanic sediments. It is postulated that the diapiric features which are present in Atlantic oceanic sedimentary horizons were formed in a narrow but growing Mesozoic proto-Atlantic. The early Atlantic was marked by restricted circulation with resultant organic-rich clays. Post-Cretaceous initiation of a strong thermohaline circulation pattern was in response to the widening of the Atlantic and the addition of cold polar waters, and it changed the sedimentary environment from reducing to oxygenated. — Authors' abstract

Schnoes, H. K. *See* Simoneit, B. R. 00905

00642 **Scholz, Christopher H.** Microearthquakes on the San Andreas fault and aftershocks of the San Fernando earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 33-37, illus., table, 1971.

Monitoring of microearthquake activity along the San Andreas fault between Gorman and Valyermo in the four days following the San Fernando earthquake of February 9, revealed thousands of aftershocks but only 16 events that could have originated from the San Andreas fault. To date, only two of these have been positively identified as originating on the San Andreas. The San Fernando aftershock activity decayed exponentially with an exponent near -1 in the first 120 hr following the main shock. Most shocks were within an area 25 km wide directly southwest of the main shock; most intense activity was in a 5- to 10-km-wide band trending 15 km southwest with a secondary parallel zone of high activity 10 km to the southeast. First motions for most aftershocks are consistent with thrust faulting with a left-lateral component on an E-W fault. — VSN

00810 **Schumann, H. H.; Poland, J. F.** Land subsidence, earth fissures and groundwater withdrawal in south-central Arizona, U.S.A. [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 295-302, illus. [1971].

Land subsidence in western Pinal County, south-central Arizona, is related to ground-water withdrawal and resultant water level declines. Differential subsidence and earth fissures have damaged irrigation systems, interstate highways, and railroads and have necessitated rerouting of a proposed aqueduct. Subsidence was first detected in 1948. The maximum documented subsidence from 1948 to 1967 is 2.30 m. Large-scale pumping for irrigation from wells that penetrate as much as 700 m of

permeable sediments has lowered water levels as much as 61 m. Net water-level declines correspond with subsidence and water-level fluctuations correlate with sediment compaction and expansion. Measured compaction, 1965-67, in the upper 253 m accounts for only 65 percent of measured subsidence. Numerous earth fissures, as much as 12.8 km long, occur in the alluvium and transect natural drainageways. Some of the fissures appear on the periphery of the subsiding areas and may be tensional breaks. — Authors' abstract

00951 **Schurr, Sam H.; Homan, Paul T.** (and others). Middle eastern oil and the western world — Prospects and problems: New York, American Elsevier Publishing Company, 206 p., illus., tables, 1971.

An outstanding feature of international oil trade is the economic interdependence between large producing countries of the Persian Gulf region and North Africa and large consuming countries of Western Europe, Japan, and United States. The United States is relatively unimportant in oil trade with the Middle East and Africa but if its level of import should change significantly, impact on world oil flows would be enormous; its excess productive capacity for liquid fuels has been a factor in emergency supplies to Western Europe, and five of seven major international oil companies are U.S. corporations. Part 1 discusses world oil production and consumption and includes a review of liquid fuel prospects from unconventional sources in North America (shale oil, coal, tar sand) and of potentials of the North American Arctic. Part 2 examines economic importance of oil to exporting countries. — VSN

08205 **Schwarz, E. J.; Harris, D. C.** Phases in natural pyrrhotite and the effect of heating on their magnetic properties and composition: Jour. Geomagnetism and Geoelectricity, v. 22, no. 4, p. 463-470, illus., 1970.

The thermomagnetic records of natural pyrrhotite are interpreted on the basis of two phases differing in magnetic properties. The chemical composition of these phases as deduced from these records agrees with microprobe results obtained for suitable unheated specimens. The thermomagnetic method requires heating the specimens to about 310°C, but microprobe results show that loss of sulfur is confined to the surface of specimens when heated in argon at the rate of 5°C/min. Results obtained with both methods indicate homogenization of specimens at 400°C which may be due in part to appreciable loss of sulfur. The thermomagnetic method has the advantage that finely dispersed mixtures of phases can be analyzed and their relative abundance easily estimated. — *from* Authors' abstract

Schwarzman, Elisabeth C. *See* Wilshire, H. G. 00903

00629 **Scott, Nina H.** Preliminary report on felt area and intensity, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 153-154, illus., 1971.

The felt area of the San Fernando earthquake, determined principally from response to earthquake questionnaire cards, includes about 80,000 sq mi of California, Nevada, and Arizona. A maximum intensity of VIII-XI has been assigned tentatively to a small area in the foothills of northern San Fernando Valley on the basis of catastrophic damage to various hospitals. Only slight to moderate damage was reported outside of intensity VII zone. Several reports concerning the direction of motion are quoted. — VSN

00786 **Scrimger, J. A.; Halliday, W.** Bathymetry of Pacific seamounts Bowie and Union: Deep-Sea Research, v. 18, no. 1, p. 123-126, illus., 1971.

Bowie and Union seamounts off the west coast of Canada at 53°17.8′ N. — 135°39.2′ W. and 49°32′ N. — 132°41′ W., respectively, were charted by echo soundings, and their positions were confirmed by satellite navigation. The summit of Union seamount is about eight times deeper than Bowie and is generally conical in form. Bathymetric features of the seamounts are described. — EH

Seibold, E. *See* Revelle, R. 08382

08257 **Sellmann, P. V.** Properties and distribution of two characteristic peat environments in Alaska [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 157-162, illus., 1970.

For engineering purposes Alaska can be divided into a southern peat-forming zone restricted to the maritime coastal region, and a central zone which covers large areas of the discontinuous permafrost zone. Peat in these areas differs in thickness and homogeneity and in the presence or absence of a perennially frozen state. Deposits are divided into slope, raised, and basin types, each having a predictable surface and subsurface conditions dependent on location and physical setting. Southern types are thicker and more widespread and thickness decreases northward. Basin types are thicker than slope types. Greater homogeneity in subsurface material occurs in slope and raised types for both environments. Other contrasts are based on moisture content, specific gravity, density, ice volume, and void ratio. — *from* Author's abstract

Sendlein, Lyle V. A. *See* Stone, Randolph. 00765

00957 **Shacklette, Hansford T.; Boerngen, Josephine G.; Turner, Robert L.** Mercury in the environment — Surficial materials of the conterminous United States: U.S. Geol. Survey Circ. 644, 5 p., illus., table, 1971.

Mercury determinations for 912 samples of soils and other regoliths from sites approximately 50 mi apart throughout the United States are represented on a map by symbols showing five ranges of concentration. A histogram of mercury concentrations in the samples is also given. The geometric mean concentration of mercury is 71 parts per billion for all samples, 96 ppb for samples from Eastern United States, and 55 ppb for samples from western United States. Twelve samples contained at least 1,000 ppb mercury; the greatest concentration found was 4,600 ppb. — Authors' abstract

08177 **Shampine, William J.** Gazetteer of Louisiana lakes and reservoirs: Louisiana Dept. Public Works Basic Records Rept. 4, 31 p., illus., tables, 1970.

Physical data for all lakes and reservoirs having a surface area of 0.25 sq mi or more are tabulated. Included are location, drainage area, elevation, surface area, volume, use, and outlet. Available basic data are indicated. Lakes larger than 1 sq mi are ranked in order of size. [Maps give the location and reference number.] — Author's abstract

00956 **Shannon, Spencer S., Jr.** Geology and geochemical exploration of the Vienna district, Blaine and Camas Counties, Idaho: Idaho Bur. Mines and Geology Pamph. 146, 45 p., illus., table, geol. map, 1971.

The applicability of geochemical prospecting in reevaluation of a dormant metal-mining district was tested by a geologic and geochemical study of the Vienna district in the Sawtooth Mts., Idaho, where ore occurs in veins in quartz monzonite of the Idaho batholith. Silver ore was discovered in the district in 1879, but since 1889 only occasional small shipments have been made. In this survey active stream-bed and floodplain sediments were sampled near mouths of first- and second-order tributaries; tests were made for heavy metals on all samples, and for copper and zinc on selected samples. Contamination from old workings masks natural anomalies, although anomalies in Pleistocene drift may indicate ore deposits in glaciated terrane. Probability of finding new deposits in this district is moderate, and most are likely to be small and without surface expression. — VSN

Sharma, K. N. M. *See* Wynne-Edwards, H. R. 08121

00621 **Sharp, Robert V.** Ground failure on the San Fernando surface away from obviously tectonic rupture zones, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 110-111, 1971.

The San Fernando earthquake produced widespread ground fracturing in form of cracking, thrusting, and slumping across much of the surface of the sites of San Fer-

nando and Sylmar. Three kinds of ground failure by fracturing were recognized outside the major zone of tectonic movement on the San Fernando surface: ground breaks in both soil and overlying engineering structures, cracks restricted to soil near such structures, and cracks in pavements and other thin structures resting on unaffected substrate. All displacements can be related to minor topographic features and appear not related to through-going fracture systems. Methods of distinguished types of displacement produced by shaking from tectonic movement are discussed. — VSN

00889 **Sheridan, Robert E.** Geotectonic evolution and subsidence of Bahama Platform — Discussion [of paper by R. S. Dietz; J. C. Holden; W. P. Sproll, 1970]: Geol. Soc. America Bull., v. 82, no. 3, p. 807-809, illus., 1971.

The paper under discussion was published in ibid., v. 81, no. 7, p. 1915-1928, 1970; Abs. North American Geology, January 1971.

Sherman, F. B. *See* Cartwright, Keros. 00692

Shiller, G. I. *See* Gorsline, D. S. 00743

Shilts, W. W. *See* McDonald, B. C. 00878

Shoffner, Joseph E., Jr. *See* Hunsucker, John K. 08341

08206 **Shuey, R. T.; Cole, E. R.; Mikulich, M. J.** Geographic correction of archeomagnetic data: Jour. Geomagnetism and Geoelectricity, v. 22, no. 4, p. 485-489, tables, 1970.

Archeomagnetically determined values of inclination and declination are commonly reduced to a base location, the regional geomagnetic field being approximated either by the axial dipole or by a virtual dipole. We investigate the error in these approximations by using the spatial variations of the 1965 IGRF to simulate the temporal secular variation. The virtual dipole approximation is found to be significantly more accurate than the axial dipole approximation, particularly when the archeomagnetic site is at the same latitude as the base. Inclination and declination error each have a normal distribution, but the directional dispersion is not circular-normal (Fisherian). Tables are presented by which the statistical error in reduction of archeomagnetic directions to a base site can be readily estimated. — Authors' abstract

00782 **Sigler, James P.; White, Donald; Kesling, Robert V.** *Logocrinus brandoni*, a new inadunate crinoid from the Middle Devonian Silica Shale of Ohio: Michigan Univ. Mus. Paleontology Contr., v. 23, no. 13, p. 213-220, illus., tables, 1971.

A small dicyclic inadunate scytalocrinid crinoid from the Silica Shale of northwestern Ohio is described as a new species, the fourth to be definitely assigned to *Logocrinus*. From a composite of five specimens, the following characters are shown: smooth subconical to bell-shaped cup flaring in the RR circlet, containing large IBB and rather short RR; anal sac long and well developed, supported by an anal series of stout hexagonal plates on the posterior side; arms tapering from high $PbrBr_1$, more than seven times the height of the cup, branching isotomously at about $PBrBr_3$, with every other SBr bearing alternating pinnules; subpentagonal heteromorphic column confluent with cup. — *from* Authors' abstract

Silberman, M. L. *See* Hopkins, D. M. 00695

00859 **Silker, W. B.; Perkins, R. W.; Rieck, H. G.** A sampler for concentrating radionuclides from natural waters: Ocean Eng., v. 2, no. 2, p. 49-55, illus., tables, 1971.

A sampler which permits concentration of both particulate and dissolved radionuclides from large volumes of ocean and freshwater has been developed and tested. The water sample passes through a filtration section for particle removal, then through a sorption section where the radionuclides of interest are removed on sorption or ion exchange beds. Components of the sampler which contact the water are of

polyvinyl chloride construction and flow rates of about 40 l/min are employed. This sampler has been successfully employed in concentrating some 20 radionuclides from ocean and fresh waters. — Authors' abstract

Silver, L. T. *See* Kamb, Barclay. 00612

00905 **Simoneit, B. R.; Schnoes, H. K.; Haug, P.; Burlingame, A. L.** High-resolution mass spectrometry of nitrogenous compounds of the Colorado Green River Formation oil shale: Chem. Geology, v. 7, no. 2, p. 123-141, illus., table, 1971.

Basic nitrogenous compounds isolated from extracts of Green River Formation oil shale were analyzed. The major homologous constituents found were the compositional types $C_nH_{2n-11}N$ (e.g., quinolines) and $C_nH_{2n-7}N$ (e.g., [tetrahydroquinolines) with minor amounts of the $C_nH_{2n-5}N$] (e.g., pyridines) and $C_nH_{2n-9}N$ (e.g., indoles) series and traces of more aromatized nitrogen compounds. These results are correlated with the nitrogen compounds isolated from Green River Formation retort oil and are a survey of the unaltered nitrogen compounds indigenous to the shale. — Authors' abstract

Sims, P. K. *See* Austin, G. S. 08291

Sinclair, A. J. *See* White, William H. 08135

08294 **Skiles, Durward D.** A method of interring the direction of drift of the geomagnetic field from paleomagnetic data: Jour. Geomagnetism and Geoelectricity, v. 22, no. 4, p. 441-462, illus., tables, 1970.

Runcorn has shown that a moving magnetic source in the Earth's core can cause the north pole of the magnetic vector at a fixed observatory on the surface to rotate clockwise for westward motion of the source and counter-clockwise for eastward motion. Numerical calculations based on radial dipole source models of the non-dipole field show the theory can also account for the magnitude of the effect observed in the terrestrial record and, together with results of simple tests with a spherical compass and a magnetic dipole, these calculations indicate that exceptions to the rule are rare. The theory, therefore, presents a potentially powerful tool for analysis of geomagnetic secular variation from paleomagnetic and archaeomagnetic data obtained at a single locality. As an example, it is shown that paleomagnetic results from Pleistocene sediments in Japan indicate westward drift of the non-dipole field 50,000 yr ago. — *from* Author's abstract

Skougstad, M. W. *See* Brown, Eugene. 08199

08304 **Sliter, T. Wentworth.** The Empire Mine and mill, Palmer, Michigan, *in* Stonehouse, H. B., Precambrian of the Marquette area, *in* Guidebook for field trips — Geol. Soc. America North-Central Sec., May 1970: [East Lansing, Mich.], Michigan Basin Geol. Soc., p. 165-169, illus., 1970.

The Empire orebody lies stratigraphically in lower part of the Negaunee Iron Formation, on the southeast limb of Marquette synclinorium, which opens and plunges to the west for about 35 miles. Two ages of metamorphism have been described: early Precambrian with intrusion of tonalite and granodiorite; late Precambrian when the synclinorium was formed. The Empire orebody falls within the chlorite zone, the Republic orebody at west end of the synclinorium, within the sillimanite zone. The Empire orebody is divided into five iron formation facies, each several hundred feet thick: lower undifferentiated; magnetite-carbonate-silicate-chert; magnetite-chert-carbonate; iron formation and clastic interbeds; upper undifferentiated. The formation dips 30°-40° WNW, is extensively faulted, cut by vertical chlorite dikes and at least four joint sets. Rock types and the nature of iron enrichment are described, with review of Man's theory (1953) of origin. — GDC

Smith, Alan Lewis. *See* Moussa, Mounir T. 08317

00681 **Smith, Avery E.** Map showing bedrock topography and subcrop of selected beds beneath alluvial deposits of the Panther quadrangle, Daviess County, Kentucky: U.S. Geol. Survey Misc. Geol. Inv. Map I-598, scale 1:24,000, 1971.

Smith, Avery E. *See* Goudarzi, Gus H. 00716

00708 **Smith, Guy-Harold.** (editor). Conservation of natural resources, 4th edition: New York, John Wiley and Sons, 685 p., illus., table, 1971; first published, 1950.

The recognition of pollution and waste has spurred a new interest in the old science of ecology, with efforts to clean up the environment and process waste products. The 20 contributors to this edition, 7 of them new, hope the many problems related to adequacy of the resource base to support the nation's economy and security will be better understood. Separately cited are five chapters, by: L. A. Wolfanger, W. A. Rockie, J. H. Garland, G-H. Smith, and E. W. Miller. — GDC

00711 **Smith, Guy-Harold.** Conservation of mineral resources, Chap. 15 *in* Conservation of Natural Resources (Guy-Harold Smith, editor): New York, John Wiley and Sons, p. 373-399, illus., tables, 1971.

Minerals in the earth's crust, unlike most other natural resources, are concentrated enough to form ores; once mined, treated, and put to use, they cannot be quickly replaced. If the widely used metals were uniformly dispersed in the crust, their recovery in adequate amounts would be impossible or economically unfeasible. Combustible materials once used are gone forever; many metals can be reclaimed for use over and over again. Mining and processing methods could result in least waste and maximum protection of unmined portions of mineral deposits; with improved technology, low-grade deposits may be workable in the next generation. Substitute materials are being found for the extravagant Americans. Many undiscovered ore deposits may yet be in areas not thoroughly explored. Both air and sea water hold a great variety of elements, but in very small quantity. It may become feasible to recover rich nodules from sea bottom. — GDC

Smith, James G. *See* MacKevett, E. M., Jr. 00685

08395 **Smith, Stephen V.** Calcium carbonate budget of the southern California continental borderland: Hawaii Inst. Geophysics [Rept.] HIG-70-11, 174 p., illus., tables, 1970.

Calcium carbonate sedimentation of the southern California continental borderland is examined by means of a budget. Carbonate transfer is the change in amount of calcium carbonate in the borderland with time; it can be divided into deposition, mechanical transfer other than deposition, biological transfer, and chemical transfer. Most borderland carbonate deposition occurs on basin floors and slopes; the rate is 125×10^{16}g/yr. Aragonite and Mg-calcite percentages decrease with depth, dolomite percentage is a function of geographic coordinates, and total carbonate content is independent of depth and geography. Potentially important forms of mechanical transfer include river influx, aerial transfer, and ocean current transfer; only river influx is an important borderland carbonate transfer process. Biologic transfer includes only input, and chemical transfer involves solution on the basin floor where waters are enriched with solution products. — *from* Author's abstract

08322 **Snelgrove, Alfred K.** Opportunities in geology and geological engineering: New York, Universal Publishing and Distributing Corp. (Vocational Guidance Manuals, Career Series), 159 p., 1970.

This guidance manual has 11 chapters as follows: scope of geology, geological engineering, and other geosciences; historical background; student enrollments; employment; educational preparation; financing an education; philosophy of geology; getting started; what geologists do; other opportunities; and geoscience organizations and their literature. Six appendixes list career pamphlets and guides, financial aids, degree program index, major geoscience organizations, regional sources of geological information and discuss ethics of the geologist. — VSN

08256 **Solopov, S. G.; Volarovich, M. P.; Korchunov, S. S.; Tsuprov, S. A.; Mogilevskii, I. I.; Abakumov, O. N.** Physical and mechanical properties of peat [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 155-156, 1970.

The study of the macrostructure of undisturbed peat by the radioisotope method and the measurement of the water potentials render it possible to find the direction of the migration of water and to select the most rational method of draining a peat deposit. Peat is not an absolutely elastic body. The deformation of a peat bed resulting from pressure is expressed by a broken straight line with two inflection points. The studies carried out in the USSR revealed the importance of dispersion in improving physical and mechanical properties of sod fuel, i.e., unit weight, strength, etc. The production however, of high quality sod fuel from peat with a water content below the plastic limit involves deaeration of raw peat. — Authors' abstract

08192 **Sörensen, H.** Low-grade uranium deposits in agpaitic nepheline syenites, south Greenland, *in* Uranium exploration geology — Panel on uranium exploration geology, Vienna, 1970, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 151-159, illus., tables, 1970.

The latest major intrusion in the Precambrian Gardar alkaline igneous province in south Greenland is the Ilimaussaq massif which is made up mainly of agpaitic nepheline syenites. The latest members of the intrusion, lujavritic nepheline syenites, are locally enriched in U and Th. Three main types of deposits are distinguished: (1) steenstrupine and monazite/rhabdophanite in analcime-natrolite rich fine-grained lujavrites without eudialyte, 200-600 ppm U, 200-2000 ppm Th; (2) steenstrupine, monazite/rhabdophanite and thorite in medium- to fine-grained lujavrites and their contact-metasomatically altered fine-grained lujavrites and lavas of the roof of the intrusion, 100-3000 ppm U and 50-13,000 ppm Th; and (3) late hydrothermal veins associated with the lujavrites which are enriched in U, Th, RF, Be, Nb, Li, etc., but are of limited extent. — *from* Author's abstract

08293 **Sörensen, Henning; Leonardsen, Erik S.; Petersen, Ole V.** Trona and thermonatrite from the Ilímaussaq alkaline intrusion, South Greenland (Contribution to the mineralogy of Ilímaussaq No. 17): Geol. Soc. Denmark Bull., Dansk Geol. Foren. Medd., English edition, v. 20, pt. 1, p. 1-19, illus., tables, 1970.

Powdery trona and thermonatrite have been found as crusts on walls of cavities in ussingite in a drill core in the northern part of the Ilímaussaq intrustion. The ussingite is a core in a thin vein intersecting naujaite enriched in villiaumite. Optical and X-ray data of the minerals are identical to those of trona and thermonatrite from saline deposits. Aggregates of sodium carbonate contain grains of ussingite, villiaumite, tugtupite, analcime, sodalite(?) and natrolite(?). The sodium carbonates were probably deposited at low temperature from strongly saline "brines" trapped in cavities in ussingite. The villiaumite was formed at higher temperatures and appears to be earlier than ussingite. The drill core, like other villiaumite-bearing cores from Ilimaussaq, is covered by an efflorescence of sodium acetate trihydrate, also associated with sodium carbonates, which was formed after collection of the drill core. — *from* Authors' abstract

Southard, John. *See* Boucot, Arthur J. 08184

00936 **Southwick, D. L.; Reed, John C., Jr.; Mixon, R. B.** The Chopawamsic Formation — A new stratigraphic unit in the Piedmont of northeastern Virginia: U.S. Geol. Survey Bull. 1324-D, p. D1-D11, illus., tables, 1971.

The name Chopawamsic Formation is introduced for a sequence of felsic, intermediate, and mafic metavolcanic and metasedimentary rocks in northeastern Virginia. No fossils have been found in the Chopawamsic, but it conformably underlies the Quantico Slate of Ordovician age and conformably overlies and interfingers with mica gneiss of the Wissahickon Formation of late Precambrian(,) age. The unit is estimated to be 6,000-10,000 feet thick. It is very likely correlative with the volcanic rocks beneath the Arvonia Slate in central Virginia and with the James Run Gneiss and volcanic complex of Cecil County, Md. It may also be correlative with parts of

the sedimentary and volcanic sequence of the Carolina slate belt. — Authors' abstract

00902 **Spall, Henry.** Precambrian apparent polar wandering — Evidence from North America: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 273-280, illus., table, 1971.

Using isotopically dated Precambrian rocks, five groups of pole positions can be defined for the Precambrian of North America that are consistent for rock units from widely separated areas. These are: Keweenawan trend, 1000-1200 m.y.; Mackenzie trend, 1200 m.y.; Elsonian trend, 1200-1375 m.y.; Animikie-Sudbury trend, 1600-2060 m.y.; Matachewan-Stillwater trend, 2450-2485 m.y. An apparent polar wandering path can be constructed between the trends, that will also incorporate data from rock units of uncertain age, such as the Belt and Grand Canyon Series. Using an average rate of apparent polar wandering of 1° per 5 m.y. during the Phanerozoic for comparison, it suggests that the Precambrian was marked by long quasistatic intervals in which the rate of polar shift was much less than 1° per 5 m.y. separated by short periods of fairly rapid polar shift of much greater than 1° per 5 m.y. — VSN

00863 **Speer, John H.; Melton, Frank A.** Outcrop geomorphic study of basal unconformities and related movements, upper Gulf Cretaceous basin of Oklahoma and Arkansas: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 241-253, illus., 1971.

Projected profiles drawn from published topographic maps across the outcrop of the Trinity Group show the basal erosion surface to be preserved only a few miles updip from the outcrop. Changes in the rate of slope along the strike indicate that the surface has been affected by late or post-Comanchean pre-Woodbine movements. The present rate of slope ranges from about 30 ft/mi to 130 ft/mi or more. Similar profiles for the Woodbine show the basal surface to be preserved an even shorter distance updip from the outcrop. The present rate of slope ranges from as little as 20 ft/mi to 80 ft/mi or more. The difference in the slope rates of the two surfaces indicates that the Ouachita Mountains in Arkansas were uplifted more than 1,200 ft during that interval of time. — *from* Authors' abstract

Speir, William H. *See* Stephens, John C. 00818

08315 **Spencer, Randall S.** Geology of the outer coastal plain, southeastern Virginia, Chesapeake-Norfolk-Virginia Beach, Pt. 1 *of* Atlantic Coastal Plain Geol. Assoc. Guidebook, 11th Ann. Field Conf., 1970: [Norfolk Va.] Old Dominion Univ., 32 p., illus., table, 1970.

This area is characterized by low altitude and relief east of the Suffolk scarp. Studies of the terraces and scarps under Shattuck's terrace formation concept combined the geomorphic and stratigraphic entities of features. Later work showed that this concept was not valid, and that terrace-formation nomenclature should be abandoned in favor of separate morphologic and stratigraphic terms. Structures in the subsurface can be divided into those parallel to the Appalachian trend, and those at a high angle to it. Geophysical studies indicate an epicentral line following the James River. Strata include the Tertiary Yorktown Fm., five Pleistocene formations, and the Holocene Dismal Swamp Peat. Nine short sections, and a block diagram are included. Possible crustal movement in the Quaternary is discussed. A road log is included. — ESL

Spiller, Judith. *See* Rollins, Harold B. 00946

Sproll, Walter P. *See* Dietz, Robert S. 00890

Stallard, Alvis H. *See* Burgat, Virgil A. 08414

00851 **Stanley, K. O.** Tectonic and sedimentologic history of Lower Jurassic Sunrise and Dunlap Formations, west-central Nevada: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 454-477, illus., tables, 1971.

The Sunrise and Dunlap Formations crop out in the structurally complex mountains of west-central Nevada. The Sunrise is generally older but partly age-equivalent to

the Dunlap, and consists of 1,200-2,400 feet of marine carbonate rocks and mudstone. The Dunlap consists of more than 4,000 feet of sandstone, carbonate rocks, breccia, conglomerate, and volcaniclastic rocks. Shallow-marine deposition (Sunrise Formation) in west-central Nevada was displaced by alluvial fan deposition (Dunlap Formation). The deposition of Dunlap "orogenic" sediments was accompanied by local warping and volcanism, but probably not by thrusting. Typical eastern Cordillera sedimentary conditions extended across Nevada, and there was no persistent Mesocordilleran geanticline in central Nevada during the Early Jurassic. — EAM

08333 **Stearns, Harold T.** Ages of dunes on Oahu, Hawaii: Bernice P. Bishop Mus. Occasional Papers, v. 24, no. 4, p. 51-72, illus., tables, 1970.

Dunes of Oahu are separated into five different ages ranging from Holocene to Illinoian. A 2-foot stand, named herein Leahi I, a low stand named the Kawela, and a later stand at present sea level named the Leahi II, of Wisconsinan age, have not been recognized before. The Wisconsinan lithified dunes are herein named the Laniola Formation, to distinguish them from the Illinoian eolianites of the Bellows Field Formation. — Author's abstract

Steinbrugge, Karl V. *See* Moran, D. F. 00635

00967 **Steineck, P. Lewis.** Middle Eocene refrigeration — New evidence from California planktonic foraminiferal assemblages: Lethaia, v. 4, no. 2, p. 125-129, 1971.

In California, faunal parameters of planktonic foraminiferal assemblages change dramatically at the Lower-Middle Eocene boundary. By analogy with modern distributional data, these changes are interpreted to reflect alteration of the prevailing water-mass character from warm-temperate to temperate. The change from warm-temperate to temperate planktonic foraminiferal assemblages occurring over the California continental borderland is reconcilable with a minimum southward displacement of 15° latitude in water-mass boundaries and lends support to the concept of a bipolar Middle Eocene refrigeration. — Author's abstract

08175 **Stelck, C. R.** Percival Sidney Warren, 1890-1970: Royal Soc. Canada Minutes Proc. 1970, ser. 4, v. 8, p. 157-161, portrait, 1970.

Stensrud, Howard L. *See* Gresens, Randall L. 00965

00818 **Stephens, John C.; Speir, William H.** Subsidence of organic soils in the U.S.A. [with French abs.], *in* Land subsidence, V. 2: Internat. Assoc. Sci. Hydrology Pub. 89 (IASH-UNESCO), p. 523-534, illus. [1971].

Organic soils subside when drained by shrinkage from drying, loss of groundwater bouyancy, compaction, wind erosion, and biochemical oxidation. Relative loss due to each factor depends on soil origin, climate, and land management. Investigations in the U.S.A. show shrinkage rate proportionate to drainage depth — the lower the water table, the greater the subsidence. Level surveys at 5-year intervals from 1913 to 1968 have established the pattern of subsidence in the Florida Everglades; initially rapid, mainly from shrinkage and compaction, then declining to a steady rate, primarily from oxidation, until underlying mineral material is reached. Arable peats have averaged sinking 3 cm per yr. Predictive studies indicate Everglades peats will be too shallow for agricultural use by 2000 A.D. Under similar drainage, organic soils subside faster in warm climates, and lowmoor faster than highmoor peats. — *from* Authors' abstract

00703 **Stephens, L. E.; Goodacre, A. K.; Cooper, R. V.** Underwater gravity surveys over the Nova Scotia continental shelf: Canadian Petroleum, v. 12, no. 4, p. 19-21, illus., 1971.

A regional underwater gravity survey of the northeastern Nova Scotian continental shelf was completed in 1970, and included Cabot Strait, Laurentian Channel and parts of Saint Pierre Bank and the Scotia Shelf. An average of 16 underwater gravity stations per day was established on a 15-km grid during three cruises on the CNAV

Sackville. The LaCoste and Romberg underwater gravimeters H2G and G25 were used to make gravity observations on the ocean floor. A simplified Bouguer anomaly map is presented. Bouguer anomalies become more positive seawards and vary in magnitude from -50 mgal for the Orpheus anomaly to 91 mgal at the continental margin in the southeastern corner of the area. Primary geologic influences on the gravity field are density variations within pre-Carboniferous basement and between overlying Carboniferous sedimentary basins and the basement. Major anomalies are described. — VSN

Stevens, George. *See* Bonyun, David. 00749

Stewart, John H. *See* McKee, Edwin H. 00962

00765 **Stone, Randolph; Sendlein, Lyle V. A.** Recharge to ground water from the West Nishnabotna River: Iowa Acad. Sci. Proc. 1970, v. 77, p. 282-289, illus., tables, 1971.

Surface water budgets, calculated from base-flow discharge data, for several reaches of the West Nishnabotna River in southwestern Iowa reveal two reaches with anomalously small incremental discharges that cannot be accounted for through evapotranspiration at the time of the discharge measurements nor can they be related to losses associated with shallow ground-water withdrawals near the river. The small incremental discharges are interpreted as resulting from influent conditions at natural ground-water recharge sites within each reach. The southernmost of the two sites, between Malvern and Randolph, is located near the juncture of a major buried bedrock valley, the Fremont Channel, and its tributary (Sendlein et al., 1968), which may be conducting the influent river water into the subsurface, away from the river. — *from* Authors' abstract

08303 **Stonehouse, Harold B.** Precambrian of the Marquette area, Michigan, *in* Guidebook for field trips — Geol. Soc. America North-Central Sec., May 1970: [East Lansing, Mich.], Michigan Basin Geol. Soc., p. 159-177, illus., geol. map, 1970.

At the east end of the Marquette synclinorium, lower Precambrian basement rocks are unconformably overlain by metasediments of the Animikie Series, all intruded by upper Precambrian basic Keweenawan dikes, and overlain by Cambrian-Precambrian Jacobsville Sandstone and Quaternary sediments. A geological column accompanies brief descriptions of the named formations, intrusives, and structure. A more detailed section on the Empire mine in Palmer, by T. W. Sliter is separately cited. Of particular interest are problems of origin of the sedimentary iron formations, exposure of classical Precambrian structure, and possible solution of some problems with better definition by recent detailed mapping. Among these are paleoecology and sedimentology in relation to the similar North Shore of Lake Huron, crustal movement around the Lake Superior basin, and relationships on margins of Paleozoic sediments. — GDC

08132 **Storer, John E.** New rodents and lagomorphs from the Upper Miocene Wood Mountain Formation of southern Saskatchewan: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1125-1129, illus., 1970.

Diagnoses and illustrations of the holotypes and paratypes are given for two new genera and seven new species of the mammalian orders Rodentia and Lagomorpha from the Upper Miocene Wood Mountain Formation of southern Saskatchewan. Taxa named include the eomyid *Adjidaumo russelli*, sp. nov.; the heteromyids *Perognathus saskatchewanensis*, *Perognathoides kleinfelderi*, and *Peridiomys borealis*, spp. nov.; the entoptychine geomyid *Lignimus montis*, gen. et sp. nov.; and the ochotonids *Hesperolagomys fluviatilis*, sp. nov., and *Russellagus vonhofi*, gen. et sp. nov. All taxa treated in this paper are from the Kleinfelder Farm locality, near Rockglen, Saskatchewan. More detailed descriptions and comparisons will be given in a subsequent publication. — Author's abstract

00919 **Strain, William S.; Hoffer, Jerry M.** The El Paso meteorite: Meteoritics, v. 6, no. 1, p. 15-19, tables, 1971.

The El Paso meteorite is a medium grained, olivine-hypersthene, L-4 chondrite. It weighed about 276 g at recovery in 1950. Chondrules make up about 65 percent of the meteorite; four varieties can be recognized. Olivine and orthopyroxene are the most abundant minerals, followed by kamacite and taenite. Modal and normative minerals are tabulated. Chemistry and mineralogy of the El Paso agree with those of olivine-hypersthene meteorites. — ESL

Strauss, Michael E. *See* Lee, Kenneth L. 00817

00762 **Strimple, Harrell L.** Echinoderm zonules in the Devonian of Iowa: Iowa Acad. Sci. Proc. 1970, v. 77, p. 249-256, illus., 1971.

A tentative framework of ten echinoderm zonules is proposed for the late Middle Devonian Cedar Valley and Upper Devonian Shell Rock and Lime Creek Formations of Iowa, each with three members. Zonules in ascending order are: *Megistocrinus clarki*, *Hexacrinites*, *Euryocrinus*, *Strobilocystites*, for Rapid Member of Cedar Valley; *Agelacrinites*, *Belanskicrinus*, *Desmidocrinus*, Mason City Member of Shell Rock; *Xenocidaris*, *Dactylocrinus*, Cerro Gordo Member of Lime Creek; Nortonechinus owenensis, Owen Member of Lime Creek. Echinoderm faunas are listed and discussed for each zonule and for the Thunder Bay Formation, Michigan, and Mineola Formation, Missouri, correlatives of the Cedar Valley Formation; it is postulated that the *Dolatocrinus*-bearing Thunder Bay Formation is slightly older than the *Stereocrinus*-bearing Rapid and Mineola. — VMJ

Stroud, Robert A. *See* Kerr, Paul F. 00865

08400 **Stumm, Werner; Morgan, James J.** Aquatic chemistry — An introduction emphasizing chemical equilibria in natural waters: New York and London, Wiley-Interscience, 583 p., illus., tables, 1970.

The aim of this book is to present a quantitative treatment of the variables which determine the composition of natural waters. Concern is with the chemical behavior of all natural systems including lakes, sea water, rivers, estuaries, ground water, and water treatment systems. Following an introductory chapter, ten chapters discuss chemical thermodynamics of natural waters; acids and bases; dissolved carbon dioxide; precipitation and dissolution; metal ions in aqueous solution; oxidation and reduction; regulation of chemical composition, solid-solution interface; and case studies — phosphorus, iron, and manganese. — VSN

00830 **Sturm, Edward.** High-resolution paleocurrent analysis by moving vector averages: Jour. Geology, v. 79, no. 2, p. 222-233, illus., 1971.

Analyses of paleocurrents are based on averaging or summing techniques of directional data and are aimed at finding the primary directions of sediment transport, the directions of source areas, or the outlines of basins of deposition. It is suggested that the resolution achievable by these techniques can be increased by using the optimum or ideal summation limits. The outlines of basins or dispersal patterns can be located from differences between vector averages or sums of adjacent sections or submatrices of the total array of data. These differences are at their maximum when the span of the submatrix over which summing is carried out happens to coincide with the extent of the paleocurrent basin. — *from* Author's abstract

Suhr, N. H. *See* Ingamells, C. O. 00846

Swain, Albert M. *See* Hall, John W. 00691

00981 **Sweet, W. C.; Bergström, S. M.** The American Upper Ordovician standard—[Pt.] 13, A revised time-stratigraphic classification of North American upper Middle and Upper Ordovician rocks: Geol. Soc. America Bull., v. 82, no. 3, p. 613-627, illus., 1971.

Conodont correlations between the Lexington, Kope and Clays Ferry Formations of the Cincinnati region and formations of the Trenton Group of New York and Ontario indicate close biostratigraphic accordance between the base of the Edenian Stage

and the top of the Shermanian Stage. Concepts of and names for Cincinnatian Stage have been stabilized since 1915, but there is no agreement or uniformity of nomenclature for upper Champlainian time-stratigraphic units. Thus we propose that the top of the Champlainian Series be drawn at the top of the Shermanian Stage and that this be succeeded in the standard time-stratigraphic classification of the North American Ordovician by Edenian, Maysvillian, and Richmondian Stages, included collectively in the Cincinnatian Series. — *from* Authors' abstract

00899 **Szabo, B. J.** A comment concerning the applicability of the "open system" model to dating of fossil bones from San Joaquin soil, California: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 252, table, 1971.

An average Th-230 "open system" date of 83,000 ± 25,000 yr has been obtained on four samples of fossil bone from the San Joaquin soil at the Davis fossil bone site near Sacramento, Calif. Within limits of error, this date is in good agreement with the average closed system date of 103,000 ± 10,000 yr of the Teichert site obtained by Hansen and Begg (1970). — VSN

00975 **Szalay, Frederick S.** Cranium of the Late Palaeocene primate *Plesiadapis tricuspidens*: Nature, v. 230, no. 5292, p. 324-325, illus., 1971.

A new reconstruction has been made of the lateral view of the somewhat crushed and damaged skull and mandible of *Plesiadapis tricuspidens* which is the only nearly complete cranium of a Paleocene primate. The main differences from past reconstructions are in the interpretation of the splanchnocranium and the occlusal relationship of the enlarged incisors. — DBV

00670 **Szekely, J.; Reitan, Paul H.** Dike filling by magma intrusion and by explosive entrainment of fragments: Jour. Geophys. Research, v. 76, no. 11, p. 2602-2609, illus., table, 1971.

Two mechanisms of material transport in dikes, viz., flow of a viscous magma and explosive entrainment of fragments in a gas, are examined quantitatively. For magma intrusion the asymptotic behavior of the system is examined by investigating the heat and fluid flow problems separately. For a given set of physical and geometrical conditions, limiting values of variables consistent with the mechanism may be computed. For some dikes too narrow to be satisfactorily explained by the magma flow representation, properties of an alternative model are developed. This model postulates that on the formation of a deep fissure a very sharp pressure gradient would develop at its base. The pressure gradient would lead to the formation of a shock wave and explosive evolution of volatiles that would be accelerated to near sonic velocity and entrain substantial quantities of fragmental material. — Author's abstract

00824 **Takasaki, K. J.** Preliminary report on the water resources of southeast Maui, Hawaii: Hawaii Div. Water and Land Devel. Circ. C58, 37 p., illus., tables, 1971.

Southeast Maui comprises about 135 sq mi in the southern part of Haleakala National Park and the southern slope of Haleakala. Mean annual rainfall is about 40 in. Surface rocks are lava flows of the Kula Volcanic Series or highly permeable rocks of the Hana Volcanic Series which overlies the Kula. Small, perched ground-water bodies, although not always permanent, are important sources of water since they occur at all altitudes in isolated areas and also help maintain perennial flow in upper reaches of some streams. Basal water is poorly developed in near-shore, low areas in the central and western parts due to high permeability of the rocks and low recharge by rain; it is better developed in the east because of increased recharge. Dike-impounded water bodies are likely in rift zones. Principal water needs include livestock supply and public use in the national park and its proposed extension. — *from* Author's abstract

08285 **Takeuchi, H.; Uyeda, S.; Kanamori, H.** Debate about the Earth — Approach to geophysics through analysis of continental drift (revised edition): San Francisco, California, Freeman, Cooper and Company, 281 p., illus., tables, 1970; originally published 1967.

Tan, F. C. *See* Ingamells, C. O. 00846

08193 **Tanner, William F.** Triassic-Jurassic lakes in New Mexico: Mtn. Geologist, v. 7, no. 4, p. 281-289, illus., 1970.

The method of using sand grain size and wave-type ripple mark spacing to estimate water depth and wave heights is applied to Triassic and Jurassic rocks in central and northern New Mexico and adjacent areas. During accumulation of the Chinle Formation, the area was mostly low rolling hills and floodplains with one or more lakes, particularly in late Chinle. In most of Entrada time (Jurassic) the area was covered with sand dunes which were reworked in later Entrada time by running water and waves, the forerunners of the large lake of Todilto time. The large Todilto lake extended at maximum more than 350 km E-W and 275 km N-S and was still present in early Morrison time, but decreased and vanished before accumulation of silts and clays characteristic of Morrison deposits. Land slopes changed from westerly in Chinle to centripetal in late Chinle to early Morrison, to easterly in late Morrison. — VSN

Tarr, A. C. *See* Espinosa, A. F. 00627

Tauxe, George W. *See* Yeh, William W.-G. 00653

08411 **Tempelman-Kluit, D. J.** Stratigraphy and structure of the "Keno Hill Quartzite" in Tombstone River — Upper Klondike River map-areas, Yukon Territory (116 B/7, B/8): Canada Geol. Survey Bull. 180, 102 p., illus., tables, geol. map, 1970.

New evidence suggests that the "Lower Schist" and "Keno Hill Quartzite" formerly included in the Precambrian Yukon Group, are, respectively, Jurassic and Lower Cretaceous. The formations overlie Upper Triassic limestone. Two new unnamed formations of slate and siltstone, probably of Lower Cretaceous age, are described. The "Keno Hill Quartzite" is an 1,800-ft-thick succession of submature, massive, fine-grained orthoquartzite with interbedded black slate. A thin sandy limestone member occurs in its upper part, and a 600-ft-thick, continuous vertically differentiated tholeiitic diabase and gabbro sill that intrudes the formation follows a slate member in the lower part of the formation. The "Keno Hill Quartzite" is probably derived from late Paleozoic clastic rocks in northern Yukon and deposited under shallow marine conditions; the upper part may be nonmarine. The central Yukon was tectonically quiet during Early Triassic; miogeosynclinal conditions prevailed during Mesozoic. — *from* Author's abstract

08149 **Tempelman-Kluit, Dirk J.** The relationship between sulfide grain size and metamorphic grade of host rocks in some strata-bound pyritic ores: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1339-1345, illus., tables, 1970.

New data concerning the grain size of sulfide minerals in some ore deposits surrounded by metamorphosed silicate host rocks is presented. These indicate that average grain size of ore and grain size range of individual sulfide minerals show fair correlation with metamorphic grade of host rocks. — Author's abstract

08308 **Terasmae, J.** Quaternary palynology — Its scope, problems and potential uses, *in* Perkins, B. F., editor, Geoscience and Man — V. 1, Proceedings of Am. Assoc. Stratig. Palynologists, Ann. Mtg., 1st, 1968: Baton Rouge, La., Louisiana State Univ., School of Geoscience, p. 23-27, 1970.

During the past fifty years the scope of Quaternary palynology has widened appreciably; other kinds of microfossils besides pollen and spores are included. Use of data-processing methods and the scanning electron microscope, and research on autofluorescence of fossil pollen are new techniques available. Quaternary palynology is being used to identify and describe facies in sedimentary basins in terms of palynomorph assemblages and sediment characteristics for use in interpretation of pre-Quaternary environments. Serious deficiencies exist in current knowledge of palynomorph morphology and dispersal, deposition, and preservation. Relations between fossil palynomorph assemblages and parent populations which produced them are insufficiently known. The true potential of Quaternary palynology is evident but cannot be fully utilized until information on basic palynology is forthcoming. — *from* Author's abstract

08228 **Tewinkel, G. C.** Remote sensing services of the Coast and Geodetic Survey, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 39-42, illus., table [1970].

The six broad operational programs of the U.S. Coast and Geodetic Survey, the extent of their operations in Alaska, and the application of remote-sensing techniques in the programs are outlined. — EH

08125 **Thapar, M. R.** Rayleigh wave propagation and perturbed boundaries: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1449-1461, illus., tables, 1970.

Theoretical and experimental studies of Rayleigh wave propagation along perturbed boundaries are presented. In the theoretical treatment, boundary conditions are expressed in terms of the shape of the perturbed boundary. Then, by applying a perturbation theory and the Fourier integral theorem, the perturbed parts of solutions to the wave equation are obtained in the integral form. The perturbed contributions to strain components are obtained by a numerical integration technique. The experiments are conducted on two dimensional ultrasonic models using plexiglass and plaster of paris. Theoretical and experimental results for the perturbed half-space model and the model of one layer over a perturbed half-space, are in good agreement. In general, results show an amplification of strain amplitudes of Rayleigh waves along the Gaussian perturbation in the first model and along the free surface in the second model, in the direction of propagation. — *from* Author's abstract

Thatcher, W. R. *See* Allen, C. R. 00608

Thomas, John E. *See* Upton, Brian G. J. 00856

Thomas, R. L. *See* Cronan, D. S. 08150

00918 **Thompson, Woodrow.** Rodingite near Thetford Mines, Quebec: Mineralog. Record, v. 2, no. 1, p. 45-46, illus., table, 1971.

In the Eastern Townships area of southern Quebec, thick Paleozoic metasediments and metavolcanics are intruded by Taconic dunites, peridotites, and pyroxenites, causing a wide variety of ore deposits. A rodingite dike rock at the Reed-Belanger chrome mine is discussed here. The current view is that rodingite is an alteration product, usually a metamorphosed basic dike, in an area of serpentinites. The original dikes were commonly gabbro, and were hydrothermally altered forming a very diverse mineralogy, the commonest minerals being grossularite, zoisite, and prehnite. Origin of the rodingites is discussed. The calc-silicate rocks in the Thetford Mines area have the mineralogy of rodingite, and are similar in genesis. A fine-grained garnet-feldspar combination makes up most of the rodingite at the Reed-Belanger pit. These rocks contain unique mineral assemblages that warrant further study. — ESL

Thomsen, J. M. *See* Crowley, B. K. 00721

Thomson, N. S. *See* Coker, A. E. 08410

08237 **Tibbetts, T. E.** (chairman). International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, 405 p., illus., tables, 1970.

The formal proceedings of the third International Peat Congress, held at Laval University in Quebec, August 18-23, 1968, under the joint sponsorship of the Canadian Department of Energy, Mines and Resources and the National Research Council of Canada are reported. Of the 38 scientific and engineering papers in Section 1, the 29 cited here deal with classification, stratigraphy and geography, engineering aspects, and physics and chemistry of peat. Papers in Section 2 on production, processing, and utilization of peat and peatlands are not cited. — EH

08238 **Tibbetts, T. E.** Report on world peat resources, *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 8-9, tables, 1970.

This article summarizes in tables the percentage of world resources of peat in various countries in 1963 and the percentage in world production of peat of each of these countries in 1965. Chief uses of peat are listed for various producing nations. In the United States and Canada and in most countries of Europe peat is used for horticultural purposes. — EH

08239 **Tibbetts, T. E.** Canada — A brief review of peat in Canada, 1968, *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 9-10, table, 1970.

Exploitation of Canada's extensive peat bogs which are estimated as covering more than 37,000 sq mi, is restricted almost entirely to deposits of relatively unhumified peat moss, predominantly from *Sphagnum* moss, used chiefly for agricultural and horticultural purposes. There are most than 80 peat-bog enterprises in Canada, more than half of them in the Province of Quebec. Peat moss is extracted by both hand-cutting and machinery. Assistance of the Canadian and provincial governments and of universities and industry in the study of peat is reviewed and a selected bibliography of scientific and technological studies is included. — EH

00908 **Till, Roger.** Are there geochemical criteria for differentiating reef and nonreef carbonates,: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 523-528, illus., tables, 1971.

Previous workers proposed various trace elements as geochemical indicators of reef and nonreef carbonates. Analysis of the data of Chester and Billings and Ragland shows that the concentration of some of these elements (total rock Ni, Co, Cr, V, and Ba, and acid-soluble Ni, Co, V, Pb, Ga, Cu, Fe, Mn, Zn, or K) is a function of the clay-mineral content of the rocks. This gives an energy index for the environment of deposition of the rocks and is not a direct reflection of their facies type. — Author's abstract

Timko, Donald J. *See* Fertl, Walter H. 00755

08282 **Tinkle, Lon.** Mr. De — A biography of Everette Lee DeGolyer: Boston, Mass., and Toronto, Ontario, Little, Brown and Company, 381 p., portrait, 1970.

00837 **Todd, David K.; Meyer, Charles F.** Hydrology and geology of Honolulu aquifer: Am. Soc. Civil Engineers Proc., v. 97, paper 7910, Jour. Hydraulics Div., no. HY2, p. 233-256, illus., tables, 1971.

In one sub-basin of the highly permeable basalt forming the Honolulu aquifer, the fresh water that floats upon and mixes with underlying sea water has been withdrawn at rates exceeding the sustainable yield, causing shallow drawdown cones with severe upconing of brackish water. Recharge estimated by three methods is about 5.3 mgd. By the Theis non-equilibrium method permeability of the basalt is estimated as 13,700 gpd per sq ft. Relatively impermeable caprock deposits appear to limit leakage of fresh water to the ocean or to adjacent aquifer areas to negligible amounts since withdrawal at approximately the estimated recharge rate causes no increase in salinity. This study is part of a project to develop a mathematical model and to simulate by use of a digital computer the dynamic behavior of isochlors when fresh water floats on salt water. — *from* Authors' abstract

00740 **Todd, Ruth; Low, Doris.** Foraminifera from the Bahama Bank, west of Andros Island: U.S. Geol. Survey Prof. Paper 683-C, p. C1-C22, illus., tables, 1971.

Samples from 46 short cores taken on 7 traverses from the outer bank edge to the western shore of Andros Island yielded 79 benthonic and 6 planktonic species. With some exceptions, the Holocene fauna is uniform, being composed chiefly of peneroplids, miliolids, elphidiids, and agglutinated species, and is dominated by *Archaias angulatus* and *Peneroplis proteus*. Benthonic species delineate three areas: outer bank, central bank, and nearshore. Planktonic specimens form a negligible part of the fauna. — RT

08290 **Tokarsky, O.** Hydrogeological map, Grimshaw-Chinook Valley, NTS 84C/4 and 84C/5, Alberta: Edmonton, Alberta, Research Council Alberta, with hydrogeologic profiles, explanatory notes and expanded legend available, 1970.

00647 **Trace, Robert D.; Palmer, James E.** Geologic map of the Shady Grove quadrangle, Crittenden and Caldwell Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-880, scale 1:24,000, sections, text, 1971.

The map includes structure contours on the base of Kinkaid Limestone, and a columnar section with all formations described. At least 15 coal seams are present locally, but there are no active mines at present. One well produced about 1,750 barrels of oil before it was abandoned, and other wells were dry. A tan clay might be useful for light-weight aggregate or ceramics. — ESL

00958 **Trapp, Henry, Jr.** Ground water basic data, Hettinger and Stark Counties, North Dakota: North Dakota Water Comm. County Ground Water Studies 16, pt. 2, 455 p., illus., tables, 1971.

A compilation is presented of ground-water basic data for the period 1966-69 in Hettinger and Stark Counties, N.Dak. Information includes data on about 3,060 wells and test holes and 91 springs; water-level measurements in 61 wells; logs of 544 test holes and wells; chemical analyses of 261 water samples; color values of 331 water samples; and 28 particle-size distribution curves. — VSN

08265 **Trapp, Henry, Jr.** Geology and ground-water resources of the Asheville area, North Carolina: North Carolina Div. Ground Water Ground-Water Bull., no. 16, 127 p., illus., tables, geol. map, 1970.

The Asheville area comprises 1,860 sq mi in Madison, Buncombe, Henderson, and Transylvania Counties, and is entirely within the Blue Ridge province. The area is underlain by Precambrian gneiss and schist, intruded by Precambrian(,) and Paleozoic granites and scattered Paleozoic ultramafics, and has a few late Precambrian and Cambrian clastic and carbonate rocks. Springs, found throughout the Asheville area, in Madison County are an important water source for homes and small communities. Dug wells are a source of ground water throughout the area, but bored wells are rare. The average drilled well is 120 feet deep with a yield of about 15 gal per min. Ground water in the area is slightly acid, has less than 100 ppm dissolved solids, and is soft. Waters of thermal springs at Hot Springs in Madison County are of calcium carbonate type, and temperatures are greater than 100°F. — VSN

00986 **Trowell, N. F.** Glitter Lake area, District of Thunder Bay: Ontario Dept. Mines and Northern Affairs Prelim. Maps P.670, 671, Geol. Ser., scale 1 in to 1/4 mi, marginal notes, 1971.

Discoveries of sulfide deposits in 1969-70 have encouraged prospecting. The map-area is underlain by Keewatin-type metavolcanics and Timiskaming-type metasediments, which were cut by intrusions several times. At a later period emplacement of the granitic complex resulted in formation of a migmatite-granite gneiss in the south. Foliation in the Precambrian trends east-southeast. There are few strong lineaments in the map-area, but some shear zones are evident along flow contacts and tops. — ESL

Truesdell, A. H. *See* Muffler, L. J. P. 00882

Tsuprov, S. A. *See* Solopov, S. G. 08256

00937 **Tuman, V. S.** Observation of Earth eigen vibrations possibly excited by gravity waves: Nature Phys. Sci., v. 230, no. 13, p. 101-106, illus., tables, 1971.

In two out of three records of spheroidal oscillations of the Earth observed by a cryogenic gravimeter, the energy content of even eigen vibrations was higher than the odd harmonics. It is speculated that the effect might be due to the remote possibility of tensor gravity wave pulses interacting with the Earth, coupling energy to the spheroidal eigen vibrations of the Earth with quadrupole moment. — DBV

08424 **Turner, Philip A.** RAPLOT, a computer program for data processing and graphical display for radioisotopic sand tracer study: U.S. Army Corps Engineers Coastal Eng. Research Center Misc. Paper, no. 3-70, 60 p., illus., tables, 1970.

RAPLOT II is a computer program for processing radiation and navigation data from field surveys of the Radioisotopic Sand Tracer Study, but is applicable to any survey type operation on the nearshore continental shelf. Collected data are punched onto paper tape by the data collection computer on the research vessel and later transferred to magnetic tape as input for the RAPLOT II Program. Program control parameters are on punched cards. Navigation data (ranges to two shore-based radar beacons), are edited for spurious data and then converted to rectangular coordinates. Radiation data are converted to count rate as counts per sec. Background count rate is computed and subtracted from observed count rate. Output is in printed, graphical, and magnetic tape form. Processed data are transferred to magnetic tape and made available for further processing such as generation of contour maps. — *from* Author's abstract

Turner, A. K. *See* Coffman, D. M. 00655

00897 **Turner, Grenville.** Argon 40-argon 39 dating — The optimization of irradiation parameters: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 227-234, illus., tables, 1971.

Factors involved in the measurement of K-Ar ages by the Ar-40/Ar-39 method are considered in detail. It is shown that the technique is applicable to rocks of any arbitrary age provided a suitable choice is made of the irradiation parameters, namely integrated neutron flux and sample size. The choice of these parameters is determined principally by the approximate age of the sample to be dated and to a lesser extent by the K/Ca ratio. A graphical method for selecting the optimum parameters is presented. — Author's abstract

Turner, Robert L. *See* Shacklette, Hansford T. 00957

Turnock, A. C. *See* Williams, P. G. L. 00939

Tuttle, Sherwood D. *See* Karsten, Richard A. 00764

Udintsev, G. *See* Revelle, R. 08382

00856 **Upton, Brian G. J.; Thomas, John E.; MacDonald, Raymond.** Chemical variation within three alkaline complexes in south Greenland: Lithos, v. 4, no. 2, p. 163-184, illus., tables, 1971.

Of three hypersolvus complexes of Precambrian age occurring in the same igneous province, two represent cores of deeply eroded central volcanoes, and the third a suite of trachytic and rhyolitic dikes. In each a similar suite of trachitic and comenditic magmas was intruded, the gross mineralogy and chemistry closely comparable. Such differences as exist are explicable by variation in cooling rates, controlling the degree to which rocks represent cumulates, and the extent to which excess alkalis in liquid residua were lost to atmosphere and wall-rocks. In the Kungnat Fjeld complex where cooling was slowest, alkali loss is inferred to have been greatest; hence most constituent syenites are mildly peraluminous. In the dike complex cooling was rapid, alkali loss less severe; most of trachyte/rhyolite dike rocks are mildly peralkalic. The central ring-complex of Tugtutôq represents an intermediate situation in relation to Kûngnât Fjeld and the dike complex. —*from* Authors' abstract

00604 **U.S. Geological Survey; Natl. Oceanic Atmos. Admin.** The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, 254 p., illus., tables, 1971.

This publication reports the preliminary results from field studies in the area of the San Fernando, California, earthquake of February 9, 1971, and was prepared jointly by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration. The volume includes 55 papers, 36 of which are cited separately, contributed

by personnel of various California State and U.S. Government bureaus as well as universities and commercial organizations. — VSN

00690 **U.S. Geological Survey.** Bibliography of North American geology, 1968: U.S. Geol. Survey Bull. 1268, 1301, p., 1971.

Uyeda, S. *See* Takeuchi, H. 08285

Uyeda, S. *See* Revelle, R. 08382

00704 **vanEverdingen, R. O.; Banner, J. A.** Precipitation of heavy metals from natural and synthetic acidic aqueous solutions during neutralization with limestone: Canada Dept. Energy, Mines and Resources Inland Waters Br. Tech. Bull., no. 35, 21 p., illus., tables, 1971.

An experimental study is reported of neutralization with limestone of acidic heavy-metal bearing water. Tests on samples from Paint Pots Springs in Kootenay National Park, British Columbia, indicate that most of the dissolved iron, much of the dissolved lead and zinc, and some dissolved copper and manganese could be precipitated by the method. Synthetic acidic water produced in the laboratory was also tested. Results hold some promise for treatment of acidic heavy-metal bearing drainage from sulfide-ore mines, dumps, and tailing ponds. The process has been applied elsewhere to neutralize acidic coal-mine drainage. — VSN

00862 **Vidrine, Louis O.** Production potential of deep Miocene rocks in southeastern Louisiana: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 2, p. 227-240, illus., 1971.

Hydrocarbon traps in deep Miocene strata in southeastern Louisiana occur in three east-west trends in deep-seated and piercement salt domes and combination structural-stratigraphic traps. — HWR

00729 **Vine, F. J.** Sea-floor spreading, Chap. 16 *in* Understanding the Earth, a reader in the Earth sciences (I. G. Gass; Peter J. Smith; R. C. L. Wilson, editors): Sussex, England, Artemis Press (for Open Univ. Press), p. 232-249, illus., table, 1971.

The formulation, extension, and final confirmation of the concept of sea-floor spreading occurred within a single decade, the 1960's. In one giant leap forward, this single, revolutionary, and elegant hypothesis provided us with a much greater understanding of the Earth. It simultaneously revived the older, but largely rejected, concept of continental drift and paved the way for the more modern and highly successful concept of plate tectonics. At the present time there is no serious obstacle to the acceptance of sea-floor spreading and continental drift as facts rather than theories. — ESL

00850 **Viniegra, Francisco O.** Age and evolution of salt basins of southeastern Mexico: Am. Assoc. Petroleum Geologists Bull., v. 55, no. 3, p. 478-494, illus., 1971.

Two salt basins are the Isthmian, now dated as pre-Kimmeridgian and not earlier than Oxfordian, and a second basin to the southeast with salt beds between Late Jurassic and Early Cretaceous age strata. Their development suggests a northwest to southeast marine transgression along a line of embayments marginal to the present Gulf of Mexico. This supports the concept of the Gulf being a land (shield) area prior to Cretaceous time. Tectonic features include transcurrent faults of Cretaceous-early Tertiary age and late Tertiary tension faults. — EGS

08287 **Vistelius, Andrew B.** Statistical model of silicate analysis and results of investigation of G-1 and W-1 samples: Jour. Internat. Assoc. Math. Geology, v. 2, no. 1, p. 1-14, illus., tables, 1970.

The results of analyses of standard samples G-1 and W-1 can be evaluated statistically by comparison of frequency-distribution properties of the chemical elements as determined by different laboratories with some standard distribution. Results in-

dicate that oxides from minerals of the same density have positive correlations, whereas, oxides from minerals of different density have negative correlations. Thus different results by different analysts are not a matter of precision of analysis, but rather of differentiation of sample powder particles by density and shape in the course of sample preparation. — VSN

00758 **Vitaliano, Charles J.** Capping volcanic rocks — West central Nevada: Bull. Volcanol., v. 34, no. 2, p. 617-635, illus., tables, 1971.

The Cenozoic capping lavas of west-central Nevada belong to the calc-alkaline igneous rock suite. The sequence ranges from high-alumina, low-alkali olivine basalt to andesite. The rocks are believed to be the products of crystallization of a high-alumina olivine basalt parent magma, derived from the mantle by partial melting, and differentiated by a combination of fractional crystallization and contamination with crustal material. The presence of biotite in the more mafic varieties and of oxyhornblende in the later rocks suggests that fractional crystallization took place, at least in part, in the presence of water. — DBV

08340 **Voight, Barry.** On the functional classification of rocks for engineering purposes [with French and German abs.], *in* International Symposium on Rock Mechanics [2d], Madrid, 1968, Proc.: Madrid, Spain, Soc. Española de Mecánica de Rocas, p. 131-135, illus., 1970.

A universal need exists for a generally acceptable classification of rocks for rock mechanics purposes. Any such scheme should be functionally oriented. Since experimentally-determined rock characteristics are expensive to obtain, they should be avoided for 'index property' classification schemes. Uniaxial crushing strength tests should be included, as strength information is inexpensive, easily determinable, and can be functionally important. The Deere-Miller classification categories for rock strength are recommended. Elastic properties of intact rocks can be excluded without serious loss. Knowledge of elastic properties, essential for some engineering works, can be included in specific instances. Test conditions should reflect conditions anticipated for the engineering works, can be included in specific instances. Test conditions should reflect conditions anticipated for the engineering problem. — VSN

Volarovich, M. P. *See* Solopov, S. G. 08256

VonderHaar, S. P. *See* Gorsline, D. S. 00743

00888 **Vrana, Ralph S.** Seismic activity near the eastern end of the Murray fracture zone: Geol. Soc. America Bull., v. 82, no. 3, p. 789-791, illus., 1971.

A series of earthquake epicenters express an apparent northeast-southwest trend in the ocean off Pt. Arguello. Other features on the ocean floor nearby and faulting inland indicate that the epicenter reports are accurate. At least one large quake has been reported in this zone (7.5 magnitude, 1927). Activity of the slowly moving type along the Murray may induce this activity. The San Andreas fault may also be involved. — Author's abstract

00624 **Waananen, A. O.; Moyle, W. R., Jr.** Water-resources aspects, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 119-125, illus., tables, 1971.

Effects of the earthquake on water resources included noticeable fluctuations in stages of streams and reservoirs, water levels in wells, roiling of water in water-supply systems, and short-term changes in streamflow and ground-water levels. Major damage was to hydraulic structures such as dams, reservoirs, water wells, mains, pipelines, and sewers. Hydroseisms were recorded over a distance of more than 500 km from the epicenter; seiches were common on swimming pools but not on reservoirs. Ground-water studies in the upper San Fernando Valley have indicated several barriers to ground-water flow. The E-W barrier closely parallels the San Fernando fault, the zone of ground rupture in the earthquake. Confined ground-water condi-

tions are indicated in the Sylmar subarea of the Los Angeles River valley-fill area. Few changes in levels are noted north of the barrier, but southwest of the barrier levels are as much as 80-90 m lower. — VSN

08329 **Wai, C. M.** The metal phase of Horse Creek, Mount Egerton, and Norton County enstatitic meteorites: Mineralog. Mag., v. 37, no. 292, p. 905-908, illus., table, 1970.

Results of an electron microprobe study of the metal phase and perryite inclusions in the metal of Horse Creek, Mount Egerton, and Norton County enstatitic meteorites are given. The origin of the 'pseudo-octahedral' structures observed in the metal phase of the Horse Creek and Mount Egerton 'anomalous enstatitic meteorites' is discussed. — Author's abstract

08195 **Waldman, M.; Hopkins, W. S., Jr.** Coprolites from the Upper Cretaceous of Alberta, Canada, with a description of their microflora: Canadian Jour. Earth Sci., v. 7, no. 5, p. 1295-1303, illus., 1970.

Coprolites from the Upper Cretaceous Oldman Formation of Alberta are believed to be those of small to medium-sized reptiles of aquatic habit, probably crocodiles, champsosaurs, or chelonians. The coprolites contain a microflora consisting mainly of lycopods, ferns, hemlocks, and various monocotyledons and dicotyledons, but the complete absence of any macrofloral material is taken as an indication that the coprolites are derived from carnivorous reptiles. — Authors' abstract

Wallace, Robert E. *See* Moran, D. F. 00635

08353 **Walton, Brian J.; Arnold, Allan.** Plutonic nodules in lamprophyric carbonatite dykes near Frederikshaab, south-west Greenland: Grönlands Geol. Undersögelse Bull., no. 91, 26 p., illus., tables, 1970.

A swarm of thin NW-SE lamprophyric carbonatite dikes of Mesozoic age occurs south of Frederikshaab associated with a contemporaneous, parallel swarm of thick dolerites. Apart from local country rock, inclusions in the lamprophyric carbonatites are of the following types: single crystals of olivine, mainly from the upper mantle; relatively unmodified garnet- and pyroxene-granulite nodules from a lower crustal level; nodules, and single crystals of hornblende and salite formed by metasomatic reaction between carbonatite magma and acid to intermediate lower crustal rocks; alkaline nodules developed by the same metasomatic reaction; and phlogopite megacrysts, mainly crystallized from contaminated magma. Complete chemical analyses of carbonatites and partial analyses of individual minerals are presented. — *from* Authors' abstract

00618 **Warrick, Richard E.; Joyner, William B.** Preliminary results from recording aftershock ground motion on alluvial deposits, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 91-96, illus., tables, 1971.

Six accelerographs were installed on Quaternary alluvium of San Fernando Valley and on sedimentary and crystalline bedrock in nearby hills to record aftershocks from this earthquake to determine response of different geologic environments; usable recordings were on sites in alluvium. From February 10-13, emphasis was on fast deployment, and instruments were not bolted down but placed on existing concrete slabs; from February 18 and continuing, all instruments were secured with bolts. Data from the two best recorded events (Feb. 21 at 0550 and 0715 GMT) are tabulated, and accelerograms are illustrated. No obvious relation was observed between distance from epicenters and amplitude or frequency content. Higher ground accelerations were recorded for the 0715 event, even though magnitudes and distances from epicenters of the two events were nearly the same. — VSN

Wasserburg, G. J. *See* Podosek, F. A. 00896

00781 **Wasson, John T.; Schaudy, Rudolf.** The chemical classification of iron meteorites — [Pt.] 5, Groups IIIC and IIID and other irons with germanium concentrations between 1 and 25 ppm: Icarus, v. 14, no. 1, p. 59-70, illus., tables, 1971.

Concentrations of Ni, Ga, Ge, and Ir are reported for iron meteorites belonging to two small but definite chemical groups, and other irons with Ge contents between 1 and 25 ppm. The new groups are characterized as follows: Group IIIC — structure, Off-Of; Ni percent, 11-13; Ga ppm, 11-26; Ge ppm, 8-36; Ir ppm, 0.07-0.55. Group IIID — structure, Off-D; Ni percent, 16-33; Ga ppm, 1.5-5.2; Ge ppm, 1.4-4.0; Ir ppm, 0.02-0.07. These groups may be related to each other. Most other meteorites in this Ge concentration range are found to be unique in their chemical composition. One cluster of three irons (Gay Gulch, Garden Head, and Kofa) and two of two (Santa Catharina and Twin City, Cambria and Soroti) may be genetically related. — Authors' abstract

08362 **Webb, S. David.** Fossil xenarthrans of Florida: Plaster Jacket, no. 13, [9] p., illus., 1970.

Florida's fossil record is remarkable for the diverse and abundant representation of the edentate mammals of the order Xenarthra, which originated in and radiated from South America, where many living forms are still found — although only one species of armadillo lives in Florida today. This popular guide briefly discusses genera and species of the suborders Cingulata (armored forms — glyptodonts, chlamytheres, armadillos) and Pilosa (ground sloths) that occur in Pliocene and Pleistocene deposits of Florida, and illustrates some of the features by which genera can be identified — patterns of bony plates of the armored forms and cheek teeth and claw cores of the ground sloths. — VMJ

Webb, S. David. *See* Patton, Thomas H. 08363

Weber, F. H., Jr. *See* Kahle, J. E. 00744

Weber, K. J. *See* Eijpe, R. 00866

08275 **Weigand, Peter W.; Ragland, Paul C.** Geochemistry of Mesozoic dolerite dikes from eastern North America: Contr. Mineralogy and Petrology, v. 29, no. 3, p. 195-214, illus., tables, 1970.

Analyses of over 100 dolerite dikes from eastern North America have established three major chemical types: (1) olivine-normative; (2) high-TiO_2 quartz-normative; and (3) low-TiO_2 quartz-normative; and a less common high-Fe_2O_3 quartz-normative type. Quartz-normative dikes predominate from Nova Scotia to Maryland; olivine-normative types predominate in the Carolinas, and both types are equally distributed in Virginia and Georgia. The high-Fe_2O_3 quartz-normative type may be a result of local differentiation, whereas other quartz-normative types are distinct from each other and evolved from different parental magmas. The olivine-normative type may represent these parental magmas, and either the magmas overlap in composition or only one magma is represented by olivine-normative dikes. Evidence from simple crystal fractionation models coupled with constraints on liquidus phases imposed by recent experimental studies is discussed. — *from* Authors' abstract

Weiler, Roland R. *See* Lerman, Abraham. 08273

Weintritt, Donald J. *See* Gill, James A. 00754

Weisberg, Joseph S. *See* Navarra, John Gabriel. 00766

00924 **Weiss, Herbert V.; Koide, Minoru; Goldberg, Edward D.** Selenium and sulfur in a Greenland ice sheet — Relation to fossil fuel combustion: Science, v. 172, no. 3980, p. 261-263, illus., 1971.

In the combustion of fossil fuels, selenium is mobilized in the atmosphere to a much lesser extent than is sulfur. This difference is ascribed to the chemical behavior of their respective tetravalent oxides. The ratio of selenium to sulfur in glacial ice is characteristic of terrestrial matter, and these elements may find their way to ice sheets by the formation of volatile compounds in biochemical processes. — Authors' abstract

00787 **Weiss, R. F.** The effect of salinity on the solubility of argon in seawater: Deep-Sea Research, v. 18, no. 2, p. 225-230, illus., tables, 1971.

New argon solubility measurements, using the microgasometric technique of Douglas (1964, 1965) and, in addition, a gas chromatographic technique, confirm the use of the Setchénow relation in representing the salting-out of argon in sea water. The Setchénow relation postulates that at constant temperature the logarithm of the solubility is a linear functn of salt concentration. No substantiation was found for the unusual salinity dependence implied by argon solubility data of Murray and Riley (1970). — VSN

08224 **Welch, Robin I.** (editor). The use of remote sensing in conservation, development, and management of the natural resources of the State of Alaska: Juneau, Alaska, Dept. of Econ. Devel., 133 p., illus., tables [1970].

This volume contains 25 papers presented at the Alaska Remote Sensing Symposium held at Juneau, Alaska, in December, 1969, 12 of which are cited separately. Various types of remote-sensing techniques are described as well as their applications to collecting data on the land, water, vegetation, wildlife and climatic conditions of Alaska. — EH

08234 **Welch, Robin I.** The use of remote sensing in water resource management, *in* The use of remote sensing . . . of natural resources of Alaska: Juneau, Alaska, Dept. of Econ. Devel., p. 98-102, illus. [1970].

Problems of managing Alaska's vast water resources include mapping the location and shorelines of water bodies, determining sediment loads, availability of water supply, nature of the fish and wildlife populations and habitats, and the effect of man on the water and land. Applicability of aerial photography and remote-sensing to these problems is discussed. — EH

00607 **Wentworth, Carl M.; Yerkes, R. F.** Geologic setting and activity of faults in the San Fernando area, California, *with a section on* Seismological environment by Clarence R. Allen, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 6-16, illus., 1971.

The San Fernando Valley area is underlain by a depositional basin dating from Miocene and is bordered by pre-Cenozoic crystalline basement rocks, in turn overlain unconformably by Upper Cretaceous-Cenozoic clastic sedimentary rocks. The latter sequence has been deformed by N-S compression, producing E-W folds and causing thrust faulting during late Cenozoic time along southern margins of mountain ranges. The faulting of February 9 occurred on faults not previously recognized as active; however, evidence indicates there were movements in late Quaternary time. Thus, numerous faults in the region which exhibit such late Quaternary movements should be considered active until investigated in detail. — VSN

00907 **Werner, Christian.** Expected number and magnitudes of stream networks in random drainage patterns: Assoc. Am. Geographers Proc., v. 3, p. 181-185, illus., tables, 1971.

How does a set of first-order streams "behave," i.e., what kind of resulting drainage pattern can we expect, if all topologically different patterns of stream mergers (including no merger) are equally likely? This paper deduces mathematical expressions of the number of topologically different patterns possible, the frequencies of networks by magnitude, the number of networks expected to develop, and their distribution by magnitude. Results show that the expected number of networks emerging from any sequence of first-order streams is always smaller than 3, and one of them is always identical with one of the original first-order streams. Theoretical findings are tested by using drainage network data from an area in eastern Kentucky, essentially free of geologic controls. Chi-square tests show that the empirical data follows the predicted figures closely. — *from* Author's abstract

00609 **Wesson, R. L.; Lee, W. H. K.; Gibbs, J. F.** Aftershocks of the earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 24-29, illus., tables, 1971.

Preliminary analysis of aftershock activity to the San Fernando earthquake in the period 0000 GMT, February 12, to 1600 GMT, February 13 suggests that epicenters occupy a large inverted U-shaped area north of surface breakage and define the areal extent of a thrust sheet. Focal depths generally increase northward from 5-7 km below the zone of ground breakage to 12-15 km at the northern limit. Other types of motion are apparent also. Two shocks on the western limb of the U and two on the northeastern edge indicate strike-slip faulting, while two near the northern limit indicate normal faulting. — VSN

00720 **West, Walter S.; Blacet, Philip M.** Geologic map of the Lancaster quadrangle, Grant County, Wisconsin: U.S. Geol. Survey Geol. Quad. Map GQ-949, scale 1:24,000, sections, text, 1971.

Bedrock is all of Ordovician age. Local folding is superimposed on a regional tilt to the south-southwest; structure contours on top of the Platteville Formation are included. Lead and zinc from the upper Mississippi Valley district are the most important resources, and several other potentially valuable areas were located. — ESL

00610 **Whitcomb, James H.** Fault-plane solutions of the February 9, 1971, San Fernando earthquake and some aftershocks, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 30-32, illus., table, 1971.

Preliminary focal mechanism solutions are presented for the San Fernando earthquake and 22 of the larger aftershocks ($M \geq 3.0$) during the 3 days immediately following the main shock. Assuming a double-couple mechanism for the main shock, the overall tectonic picture suggested is a main thrust-fault plane striking N. 64° W., dipping about 52° NE, and having a left-lateral strike-slip component. The upper thrust block is probably attached to crustal material to the northwest but is breaking up in a complex pattern along the southeast aftershock zone. The lower underthrust block is actively slipping with left-lateral motion against the block to the northwest along a nearly vertical strike-slip fault, which extends from the main-shock focus southwest along the aftershock zone to a point at least 10 km south of the observed surface faulting. The axis of compression derived from the main shock trends NE-SW. — VSN

White, D. E. *See* Muffler, L. J. P. 00882

00959 **White, D. E.** Water resources of Ward County, Texas: Texas Water Devel. Board Rept. 125, 219 p., illus., tables, 1971.

Ward County in the Pecos River Valley of West Texas is underlain by three major aquifers — the Allurosa aquifer, Rustler Formation, and Capitan reef. The Allurosa, the principal aquifer, comprises saturated deposits in the Tertiary Santa Rosa Sandstone and Chinle Formation equivalent, Tertiary and Quaternary alluvium, and modern dune sand. It supplied 22,600 acre-feet of water to wells in 1967; Capitan reef and Rustler Formation supplied 9,500 and 2,300, respectively. Most pumpage, 20,400 acre-feet, was for industry, of which 14,600 acre-feet was for waterflooding oil fields. Natural recharge to the Allurosa is about 12,000 acre-feet per yr; about 45,000 acre-feet is added by seepage from irrigation canals and fields. Discharge by transpiration of vegetation is 40,000 acre-feet. Quality of water ranges from fresh to brine and contamination by disposal of oil-field brines is increasing. An estimated 10 million acre-feet is stored in the Allurosa. — VSN

White, Donald. *See* Sigler, James P. 00782

00973 **White, George W.** Glacial geology of Trumbull County, Ohio: Ohio Div. Geol. Survey Rept. Inv. 80, map, scale about 1 in to 1 mi, sections, text, 1971.

Bedrock in this county is chiefly Mississippian and Pennsylvanian sandstone and shale. Old valleys are cut below bedrock surface. Drift occurs as ground and end moraines, outwash terraces, and lacustrine plains; stratigraphy of the Illinoian and Wisconsin tills is discussed. Gravel and sand deposits have been worked, and tills used for ceramic ware. Some sandstones might be of economic importance. Engineering properties of soils developed on different tills vary. — ESL

08178 **White, George W.** (editor). James Hutton's System of the Earth, 1785; Theory of the Earth, 1788; Observations on granite, 1794; together *with* Playfair's Biography of Hutton: Darien, Connecticut, Hafner Publishing Company, 203 p., illus., 1970.

The purpose of this volume is to bring together all of Hutton's geological writings that have not been previously reprinted. The larger two-volume publication of Hutton's theories was preceded by a lengthy paper published in 1788 in the Royal Soc. Edinburgh Trans., v. 1, which is here reprinted in its original form. This paper was preceded by a still earlier unsigned and undated *abstract* of a dissertation read in a Meeting of the Royal Soc. Edinburgh in 1785. *Observations on granite* is reproduced from Royal Soc. Edinburgh Trans., v. 3, pt. 2, p. 77-81, 1794, and Playfair's biography of James Hutton from ibid., v. 5, pt. 3, p. 39-99, 1805. — VSN

White, Joe E. *See* Low, Philip F. 00940

White, John S., Jr. *See* Leavens, Peter B. 08346

08135 **White, William H.; Sinclair, A. J.; Harakal, J. E.; Dawson, K. M.** Potassium-argon ages of Topley Intrusions near Endako, British Columbia: Canadian Jour. Earth Sci., v. 7, no. 4, p. 1172-1178, illus., table, 1970.

Twenty-five potassium-argon ages were obtained from granitic rocks in the Endako area of central British Columbia which are presumed to be genetically related and known collectively as the Topley Intrusions. Most of the ages cluster around 138 m.y. but some are as old as 155 m.y. and one is only 114 m.y. These data might indicate either one protracted perhaps intermittent magmatic event culminating in early Upper Jurassic or three separate and unrelated events. In either case the isotopic age is some 40 m.y. less than the age previously assigned to the Topley Intrusions on a basis of apparently good geological evidence. — Authors' abstract

White, William H. *See* Richards, T. 08138

00632 **Whitten, C. A.** Crustal-movement surveys and preearthquake strain analysis, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 161-162, illus., 1971.

Epicenters of the San Fernando earthquake and major aftershocks are near the southern end of an older arc of triangulation established in 1932 and resurveyed in 1952 and 1962; the axis of the arc, extending from San Fernando to Bakersfield in a dog-leg fashion, is perpendicular to the San Gabriel, San Andreas, and Garlock faults. Reanalysis of data from the extreme southern end of these surveys shows an accumulation of strain of 41×10^{-6} units in the period 1932-62. Direction of maximum shear for triangles covering the area of the Santa Susana fault is E-W, and further north closer to the San Gabriel fault is NW-SE; in both, direction of shear indicates right-lateral movement. The postearthquake program of reobservation includes use of a laser geodimeter, and thus uncertainties from this and future resurveys should not exceed one or two parts per million. — VSN

08259 **Williams, G. P.** The thermal regime of a *Sphagnum* peat bog [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 195-200, illus., tables, 1970.

In this study air and ground temperature measurements taken over a 3-year period in a virgin peat bog are compared with similar measurements taken at nearby mineral soil sites. The purpose of the study was to assess the significance of temperature differences that can be expected due to terrain and soil thermal properties. The

drainage of cold air into the peat bog was found to be the major factor causing minimum air temperatures to be lower over the bog than at nearby weather stations. The condition of the bog, i.e., whether it was wet or dry, thawing or snow-covered, appeared to have some effect on minimum air temperatures but was not as important a factor as air drainage. Monthly and annual average peat soil temperatures were several degrees colder than corresponding mineral soil temperatures. The peat soil temperatures were colder because heat available from radiation and convection was used for evaporation rather than for warming the soil. — Author's abstract

08115 **Williams, Harold H.; Harriss, Robert C.** Chloride and bromide in carbonate rocks in relation to the chemical history of ocean water: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1539-1551, illus., tables, 1970.

The acid soluble chloride/bromide ratios of 66 limestones and 74 dolomites and the water soluble chloride/bromide ratios of 65 limestones and 42 dolomites were determined for samples from Recent to Precambrian age (2 b.y.). A progressive increase occurs in the chloride/bromide ratio from the Precambrian to Recent and is interpreted as representing an increase in the chloride/bromide ratio of sea water over the past 2×10^9 years. It is postulated that removal of bromine from sea water by sedimentation of bromide-enriched organic matter and crustal recycling of sedimentary rocks is responsible for the increase in the chloride/bromide ratio of sea water. — Author's abstract

00939 **Williams, P. G. L.; Bancroft, G. M.; Bown, M. G.; Turnock, A. C.** Anomalous Mössbauer spectra of C2/c clinopyroxenes: Nature Phys. Sci., v. 230, no. 15, p. 149-151, illus., tables, 1971.

This article attempts to resolve the anomalous Mössbauer spectra of C2/c clinopyroxenes by examining the specimen from the Skaergaard Intrusion and a synthesized specimen. The effect seems to be due to the existence of more than two doublets in the spectrums with different QS temperature dependences. The extra doublet probably is due to the existence of two exsolved Cw/c phases possessing markedly differer.t M1 quadrupole splittings, the domain structure being fine enough to avoid giving noticeable X-ray diffraction effects. — DBV

00680 **Williams, Paul L.; Hackman, Robert J.** (compilers). Geology, structure, and uranium deposits of the Salina quadrangle, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-591, 2 sheets, scale 1:250,000, 1971.

Wilshire, H. G. *See* Best, Myron G. 00823

00903 **Wilshire, H. G.; Calk, L. C.; Schwarzman, Elisabeth C.** Kaersutite — A product of reaction between pargasite and basanite at Dish Hill, California: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 281-284, illus., tables, 1971.

Pargasitic amphibole, occurring interstitially and as veins in peridotite inclusions in basanite, has reacted with host basanite to form kaersutitic amphibole. Amphibole compositions vary with respect to distance from edge of the xenolith; Fe, Ti, and K contents are higher and Mg, Si, Na, and Cr are lower closer to the basanite. Pargasite was exposed to basanite when peridotite blocks broke open along amphibole veins during transport to the surface. Small amphibole fragments isolated in basanite show most reaction; compositional gradients in interstitial and vein amphibole are steep into peridotite where amphibole was shielded from reaction. Compositions of amphiboles so modified have no direct bearing on high pressure fractionation trends if amphibole is cognate, or on bulk composition of the upper mantle if it is accidental. — *from* Authors' abstract

08358 **Wilson, Charles W., Jr.** Geologic map of the Normandy quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 79-NE, scale 1:24,000, separate text, 1970.

08359 **Wilson, Charles W., Jr.** Geologic map of the Hollow Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 85-NE, scale 1:24,000, separate text, 1970.

08360 **Wilson, Charles W., Jr.** Geologic map of the Ovoca quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 86-NW, scale 1:24,000, separate text, 1970.

Wilson, Charles W., Jr. *See* Russell, Ernest E. 08361

Wilson, Edward L. *See* Sandhu, Ranbir S. 00813

00960 **Wilson, L. R.** Palynological techniques in deep-basin stratigraphy: Shale Shaker, v. 21, no. 6, p. 124-139, illus., 1971.

This paper is a general discussion of deep-basin palynological techniques that have been developed from investigations begun in 1946 by Wilson and Webster (1949) during an analysis of two Gulf of Mexico wells, and which have been expanded during subsequent surface and subsurface studies in other areas, notably the middle and upper Paleozoic coal and oil bearing rocks of the Arkoma and Anadarko basins of Oklahoma. Topics discussed include: geologic ranges and geographic zones and environments of deposition of principal groups of palynomorphs; palynomorph preservation and color, as affected by weathering, pressure and temperature of burial depth, chemical association, geologic age, and morphological structures; and criteria for recognition of palynomorphs recycled from older to younger stratigraphic units. — VMJ

08245 **Wilson, N. E.** Influence of track design on soil pressures and deformations [with French abs.], *in* International Peat Congress, 3d, Quebec, Canada, 1968, Proc.: Ottawa, Canada, National Research Council of Canada, p. 60-64, illus., 1970.

This research, dealing with the behaviour of soil resisting the vehicle, is complementary to previous research on mobility which deals with the performance of the vehicle. The stresses under the moving vehicle were measured to determine the influence of track design parameters and the forces resisting the passage of the vehicle. The soil stress distributions were analyzed and related the behaviour of the track to the limiting strength of the soil. This fundamental approach to mobility research relates soil stress distribution to mobility and, indirectly, to trafficability. It is possible to determine influences of the track design parameters, such as track flexibility, track geometry, etc. — Author's abstract

Wilson, N. E. *See* Glynn, T. E. 08252

Winder, C. G. *See* Mukherji, K. K. 08124

00673 **Wing, Richard S.** Structural analysis from radar imagery of the eastern Panamian Isthmus, Pt. 2: Modern Geology, v. 2, no. 2, p. 75-127, illus., table, 1971.

Radar coverage has provided surface geologic data, and reconnaissance mapping permits tentative interpretations. A belt of north-trending left lateral en echelon anticlines extends northwestward and culminates in large-scale faulted folds next to the east end of the Maje Range. Observed distortion in this belt is compatible with left-lateral movement at depth. A similar strain pattern is seen in the Maje Range. The isthmus is in the southwest corner of the Caribbean plate, which has been subject to compression from the South American plate, causing left-lateral simple shear deformation in eastern Panama. Longitudinal wrench faults, characteristic of the Maje Range, have been used last for vertical tectonic adjustment, forming an axial horst. The fault bounding the north side of the horst has been active recently near the mouth of the Bayano River, which now follows it across the nearly peneplaned west end of the Maje Range to the sea. — *from* Author's abstract

Winters, R. W. *See* Murrmann, R. P. 08191

08369 **Wise, William S.** Cenozoic volcanism in the Cascade Mountains of southern Washington: Washington Div. Mines and Geology Bull. 60, 45 p., illus., tables, geol. map, 1970.

The Cascade Mountains in the Wind River area are built of extensive deposits of Cenozoic lavas and volcaniclastic debris, all of calc-alkaline composition. The oldest

unit, Ohanapecosh Formation, correlates with the Eocene formation of that name in the Mount Rainier region; it has nearly 19,000 feet of volcanic detritus and lavas, and the upper 6,000 feet may be Oligocene. Following uplift, folding, and deep weathering, andesitic gravels and sands of the Eagle Creek Formation were deposited locally in early Miocene, eroded, and then inundated by Yakima Basalt flows in late Miocene. Pliocene folding was accompanied by eruption of andesitic and basaltic volcanoes, but only scattered plugs of diorite and diabase survive. Quaternary volcanism has been limited to extrusion of basalt from at least 10 vents; lavas are olivine, platy olivine, and low-alimina basalts. — VSN

00717 **Witkind, Irving J.** Geologic map of the Barker quadrangle, Judith Basin and Cascade Counties, Montana: U.S. Geol. Survey Geol. Quad. Map GQ-898, scale 1:62,500, sections, 1971.

00709 **Wolfanger, Louis A.** Soil orders and suborders of the United States and their utilization, Chap. 4 *in* Conservation of Natural Resources (Guy-Harold Smith, editor): New York, John Wiley and Sons, p. 55-98, illus., 1971.

The many diverse soils are classified on the basis of inherent characters including genetic significance to natural landscapes. Observable and measurable characteristics that can be determined in field or laboratory, not just by inference from the geologic formation, climate, or other condition under which soil occurs or has presumably developed, may then be matched with requirements of any desired use of soil. The system employs 23 formative syllables, mostly Latin derived, as in biology. The orders — Alfisols, Aridosols, Entosols, Histosols, Inceptisols, Mollisols, Spodosols, Ultisols, and Vertisols — and suborders, named by combining with key syllable of order a syllable featuring some characteristic of the soil, are described as to composition, physical properties, and indicated uses. A map delineates their distribution, dominant suborders indicated by numbered initial letters. — GDC

Wolfe, C. W. *See* Keidel, F. A. 00911

Wolfe, J. A. *See* Hopkins, D. M. 00695

Wones, D. R. *See* Copeland, R. A. 00894

00985 **Worsley, Thomas R.** Terminal Cretaceous events: Nature, v. 230, no. 5292, p. 318-320, illus., 1971.

A model for the terminal Cretaceous even is outlined. The climate deteriorated in late Maastrichtian due to decrease in CO_2 in the atmosphere, brought about primarily by the Late Cretaceous phytoplankton bloom responsible for worldwide chalk deposition. Lower temperatures decreased precipitation and terrestrial weathering and erosion, further reducing the supply of nutrients and carbonate available to marine phytoplankton. The carbonate compensation depth migrated upward and, when it approached the ocean surface, massive extinctions occurred. On land the latitudinal thermal gradient together with sharper seasonal and probably diurnal temperature ranges explains dinosaur extinction. Recovery resulted when curtailment of photosynthesis, resulting from removal of phytoplankton, released CO_2 to the atmosphere. The oceans remained sterile until orogeny renewed the supply of nutrients and carbonate. — DBV

00901 **Wright, J. B.** Comments on "Timing of break-up of the continents round the Atlantic as determined by palaeomagnetism" by E. E. Larson and L. La Fountain, Earth and Planetary Science Letters 8 (1970), 341-344: Earth and Planetary Sci. Letters, v. 10, no. 2, p. 271-272, 1971.

For abstract of the original article, see Abs. North American Geology, February 1971.

00845 **Wright, L. D.; Coleman, J. M.** The discharge/wave-power climate and the morphology of delta coasts: Assoc. Am. Geographers Proc., v. 3, p. 186-189, 1971.

The morphology of delta coasts can be partially attributed to opposition between the depositional tendencies of the river efflux and the marine wave-power regime. The discharge/wave-power climate of a delta may be described in terms of the magnitudes and spatiotemporal distributions of river discharge and wave power computed from hindcast deep-water wave characteristics. A FORTRAN IV computer program has been developed to facilitate the analyses, taking into account the effects of refraction, shoaling, and frictional attenuation over varying subaqueous topographies. A comparison of two deltas indicates that morphologies reflect the discharge/wave-power climates. — Authors' abstract

00733 **Wright, Thomas L.; Fiske, Richard S.** Origin of the differentiated and hybrid lavas of Kilauea Volcano, Hawaii: Jour. Petrology, v. 12, no. 1, p. 1-65, illus., tables, 1971.

Kilauea Volcano has erupted lava from its summit caldera and from two rift zones that extend from the summit towards the east and southwest. Lavas erupted from the summit differ in their olivine content and define lines of 'olivine control' on magnesia variation diagrams. Lavas erupted on the rift zones are either similar in composition to the summit lavas or are differentiated by processes involving minerals other than olivine. Differentiated lavas have less than 6.8 percent MgO. Twenty-one new analyses are presented for several differentiates of the east rift zone and for newly-discovered differentiates adjacent to the southwest rift zone. MgO content is as low as 3.9 percent and SiO_2 content as high as 56 percent. Conclusions of detailed petrochemical studies are given. — *from* Authors' abstract

Wyllie, P. J. *See* McDowell, S. D. 00828

08121 **Wynne-Edwards, H. R.; Laurin, A. F.; Sharma, K. N. M.; Nandi, A.; Kehlenbeck, M. M.; Franconi, A.** Computerized geological mapping in the Grenville Province, Quebec: Canadian Jour. Earth Sci., v. 7, no. 6, p. 1357-1373, illus., tables, 1970.

Data are recorded in the field on input documents, and from these records a data bank, now with descriptions of over 5000 outcrops, has been constructed. Lithological sorting programs based on textural and mineralogical qualities used to define rock types have been written to provide listings of some 40 potential map-units. Outcrop maps have been drawn on a computer-driven drum plotter. Structural data have been extracted and plotted in equal-area projections, and also plotted on maps directly. The system has upgraded the standard of data collection in the field, and the data bank, when made publicly available, will enable users of government geological maps and reports to reinterpret the area in their own manner. — *from* Authors' abstract

00611 **Wyss, Max.** Preliminary source parameter determination of the San Fernando earthquake, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 38-40, tables, 1971.

The seismic moment (1.5×10^{26} dyne cm) and the source dimensions ($8 < r < 21$ km) for the San Fernando, Calif., earthquake are estimated from teleseismically recorded P-waves and compared with the same parameters obtained from field observations. From the combined teleseismic and field data, the dislocation (100 cm) and stress-drop (30 bars) are estimated. — Author's abstract

Wyss, Max. *See* Lahr, John C. 00616

00663 **Wyss, Max; Hanks, Thomas C.; Liebermann, Robert C.** Comparison of P-wave spectra of underground explosions and earthquakes: Jour. Geophys. Research, v. 76, no. 11, p. 2716-2729, illus., tables, 1971.

The P-wave displacement spectra of the Milrow and Longshot explosions are compared with those of four shallow earthquakes of similar body-wave magnitude in the Aleutian Islands, using data from three vertical instruments at Pasadena, approximately 50° from the epicentral region common to the six events. A Novaya Zemlya explosion of comparable m_b was also analyzed. The peak spectral amplitude for the earthquakes occurs at periods several times larger than for comparable m_b explo-

sions, indicating that the earthquakes have source dimensions several times larger than the explosions. For T < 1.5 sec, the spectra for both types of events are comparable. The explosion spectra peak sharply in the interval T = 1 to 2 sec; earthquake spectra, however, continue to increase to a long-period level. The greatest differences in spectral amplitudes occur at periods > 3 sec. Observed differences in P-wave spectra provide a promising method for discriminating between earthquakes and underground explosions. — DBV

00650 **Yang, Chih Ted.** Potential energy and stream morphology: Water Resources Research, v. 7, no. 2, p. 311-322, illus., table, 1971.

Use of the analogy of entropy in thermodynamics reveals two basic laws which govern formation of all stream systems. The first is the law of average stream fall, which states that under dynamic equilibrium condition the ratio of average fall between any two different order streams in a basin is unity. The second is the law of least rate of energy expenditure, which states that during evolution toward equilibrium condition a natural stream chooses its course of flow in such a manner that the rate of potential energy expenditure per unit mass of water along this course is a minimum. This minimum value depends on external constraints applied to the stream. Concavity of a basin is shown to be the determinative factor in formation of a stream system. On the basis of Horton's law and the law of average stream fall, longitudinal stream profiles can be calculated. — *from* Author's abstract

00906 **Yang, Chih Ted; Sayre, William M.** Stochastic model for sand dispersion: Am. Soc. Civil Engineers Proc., v. 97, paper 7892, Jour. Hydraulics Div., no. HY2, p. 265-288, illus., tables, 1971.

The movement of sand particles is expressed in terms of steps and rest periods. The longitudinal dispersion of sand particles along the bed of an alluvial channel is formulated in a general one-dimensional stochastic model. Three different methods are suggested for determining three parameters in the model. Results indicate that the step lengths follow a gamma distribution and the rest periods follow an exponential distribution. Statistical analysis of bed configuration indicates the movement of sand particles along an alluvial bed should be closely related to the statistical properties of the bed configuration. The results of longitudinal dispersion experiments compare favorably with predictions based on the stochastic model. — *from* Authors' abstract

00653 **Yeh, William W.-G.; Tauxe, George W.** Quasilinearization and the identification of aquifer parameters: Water Resources Research, v. 7, no. 2, p. 375-381, illus., tables, 1971.

This paper uses the quasilinearization technique for handling inverse problems arising in multiboundary value problems governed by nonlinear differential equations to identify unknown aquifer parameters. The procedure involves neither curve plotting nor graphical matching and makes full use of the high-speed digital computer to integrate a system of ordinary differential equations with given initial conditions. Parameters to be identified are storage coefficient and transmissivity in a confined aquifer system. — VSN

00835 **Yemel'yanov, Ye. M.; Lisitsyn, A. P.; Koshelev, B. A.** Raspredeleniye i sostav karbonatov v verkhnem sloye donnykh osadkov Atlanticheskogo okeana [The distribution and composition of carbonates in the upper layers of bottom sediments of the Atlantic Ocean]: Akad. Nauk SSSR Doklady, v. 196, no. 1, p. 207-209, illus., 1971.

Based on published data and analyses of bottom sediments, a map was compiled at the scale of 1:20 million of the distribution of $CaCO_3$ in bottom sediments of the Atlantic Ocean. Carbonate sediments, over 30 percent $CaCO_3$, constitute over half of the ocean floor between lat. 73.5° N. and 56° S. The $CaCO_3$ content increases toward the equator reaching 90-95 percent between 38.5° N. and 28.5° S., and also increases with distance from shore. Direct relations exist between calcite composition of carbonates and their plankton foraminifera content, between aragonite and mollusks, and between magnesial calcite and bryozoa. Calcite predominates in carbonates at high latitudes, decreases with proximity to the equator, and increases with depth. The

converse holds true for magnesial calcite and aragonite content. Carbonates of chemical-biological and diagenetic origin are found only in the Caribbean Sea and Gulf of Mexico, occurring as oolites, pellets and aragonite spicules. — EH

Yen, Ben Chie. *See* Yen, Chin-lien. 00839

00839 **Yen, Chin-lien; Yen, Ben Chie.** Water surface configuration in channel bends: Am. Soc. Civil Engineers Proc., v. 97, paper 7928, Jour. Hydraulics Div., no. HY2, p. 303-321, illus., 1971.

Water surface configuration in open-channel bends depends on the geometry of the channel. Mathematical expressions for longitudinal and transverse water surface profiles are derived from the equations of motion with the aid of order of magnitude analysis. Computed surface profiles and superelevation obtained by using mathematical expressions agree well with experimental measurements of subcritical flows in trapezoidal and natural bed meandering models. The result reveals that the channel bed topography is an important factor in determining the superelevation and water surface profiles. Inadequacy of conventional approximation methods to evaluate the superelevation is also examined. — Authors' abstract

Yerkes, R. F. *See* Wentworth, Carl M. 00607

00805 **Yerkes, R. F.; Castle, R. O.** Surface deformation associated with oil and gas field operations in the United States [with French abs.], *in* Land subsidence, V. 1: Internat. Assoc. Sci. Hydrology Pub. 88 (IASH-UNESCO), p. 55-66, illus., tables [1971].

Surface deformation associated with oil and gas field operations in the United States consists of differential subsidence centering on the fields, centripetally directed horizontal displacements, and faulting. Faulting is commonly high-angle, normal, and peripheral to the subsidence bowl (Goose Creek and Mykawa, Texas; Inglewood and Kern Front, California), but may be low-angle, reverse, and central (Buena Vista, California). Strain patterns developed over these fields are similar to those measured by D. V. Deere over a Texas salt dome where all three surface effects were observed during Frasch extraction of sulfur. In this case, a central compressional zone extended out to beyond the 0.35 S isobase (S = maximum subsidence) and a surrounding tensional zone extended to the periphery of the bowl, where high-angle normal faulting occurred. — *from* Authors' abstract

Yoder, H. S., Jr. *See* Huckenholz, H. G. 00778

00625 **Youd, T. L.; Olsen, H. W.** Damage to constructed works, associated with soil movements and foundation failures, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 126-132, illus., 1971.

Soil movements and foundation failures were associated with much of the damage to structures in the northern San Fernando Valley. Tectonic movements of various kinds, including compressional (thrust), vertical, lateral, and extensional displacements, were particularly damaging to underground utilities and all types of overlying structures. Landslide movements on nearly level ground inflicted extensive damage to pipelines, canals, and light buildings, but little damage to heavier structures on massive foundations. Small landslides in hilly areas generated minor cracks and displacements causing heavy damage to single-family dwellings. Massive landslides on steep natural slopes and constructed embankments blocked major highways and nearly breached Lower Van Norman Dam. — Authors' conclusions

00643 **Youd, T. L.** Landsliding in the vicinity of the Van Norman Lakes, *in* The San Fernando, California, earthquake of February 9, 1971: U.S. Geol. Survey Prof. Paper 733, p. 105-109, illus., 1971.

Slides generated in recent alluvium in the vicinity of the Van Norman Lakes are discussed in this report. Because of the presence of two reservoirs (Van Norman Lakes) and of a confined aquifer in Little Tujunga syncline, the water table was probably not more than a few meters below the land surface at any point in the alluvi-

al areas around the lakes at the time of the San Fernando earthquake. Extensive slumping occurred in the alluvium around the margins of both lakes, and some of these slides moved down very gentle slopes. The most damaging slide formed a tonguelike feature extending northeastward from the upper lake for a distance of 1.2 km (Juvenile Hall slide); damage to facilities in its path will exceed 30 million dollars. Displacement seems of landslide rather than tectonic origin and probably was caused by partial or complete liquefaction of underlying soils during the earthquake. — VSN

00667 **Yungul, S. H.** Magnetic anomalies and the possibilities of continental drifting in the Gulf of Mexico: Jour. Geophys. Research, v. 76, no. 11, p. 2639-2642, illus., 1971.

In the light of preliminary analysis, this paper discusses whether or not the magnetic data support the hypothesis that the Gulf of Mexico is a wide open rift in the Earth's crust and if so, whether it is due to sea-floor spreading or simple tension. The principal purpose of the paper is to stimulate interest in acquiring high-resolution magnetic data in the Gulf. One possible model implies that in this particular case on this local scale, continental drift is the cause of the rise of the melt from the low-velocity channel, rather than the rise of the melt being the cause of drift as in the case of sea-floor spreading. — DBV

Zawodniak, C. D. *See* Keene, P. 08243

00702 **Zietz, Isidore; Kirby, John R.** Aeromagnetic map of the western part of the northern peninsula, Michigan and part of northern Wisconsin: U.S. Geol. Survey Geophys. Inv. Map GP-750, scale 1:250,000, 1971.

00696 **Zimmerle, Winfried.** Akzessorischer Allanit im Rattlesnake-Granite (San Diego County, Südkalifornien) und seine allgemeine petrogenetische Stellung [Accessory allanite in the Rattlesnake granite (San Diego County, Southern California (with English abs.)]: Neues Jahrb. Mineralogie Abh., v. 114, no. 3, p. 281-300, illus., 1971.

Accessory allanite in the Rattlesnake granite, in the Cuyamaca Peak quadrangle of California, and its regional distribution are described. The allanite is restricted to the central portion of the massif, which is quartz-dioritic in composition and rich in dark xenoliths. It is clearly distinguishable from allanite in the neighboring Stonewall granite on the basis of optical data. The crystal size, assemblages, and mineral paragenesis suggest that the allanite formed during an autopneumatolytic and contact pneumatolytic (rest) phase. — DBV

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Associations
Am. Assoc. Stratig. Palynologists
Proceedings, first annual meeting, 1968: Perkins, Bob F. 08307
California Div. Mines and Geology
Organization, mission: California Div. Mines and Geology. 00640
Geological Society of America
Penrose Conference, 1970, ultramafic inclusions: Best, Myron G. 00823
Highway Geology Symposium
University of Kansas, 1970 meeting, field trip guidebook: Burgat, Virgil A. 08414
International Atomic Energy Agency
Panel reports, 1970: International Atomic Energy Agency. 08156
International Peat Society
Proceedings, 3d Congress: Tibbetts, T. E. 08237
Ohio Geological Society
Guidebook, Ohio, Middle Devonian rocks: Janssens, A. 08372
Pan American Institute Geography and History
Objectives, activities, accomplishments: Gerlach, Arch C. 08368

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Bibliography
Gold
Geochemistry, genesis, exploration, annotated: Cooper, Margaret. 00932
North America
General, 1968: U.S. Geological Survey. 00690
Oklahoma geology
1970, with index: Rose, William D. 00972
Shorelines
Quaternary, annotated, 1965-1969: Richards, Horace G. 08190
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DeLury, Justin Sarsfield: Brownell, G. M. 08172
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Playfair's biography, reprinting: White, George W. 08178
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Klamath Mountains, lode gold districts: Hotz, Preston E. 00934
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San Fernando earthquake area: Oakeshott, Gordon B. 00904
Earthquakes
1971, February 9, San Fernando: Greensfelder, Roger. 00791
1971, February 9, San Fernando, aftershocks: Hanks, Thomas C. 00644
1971, February 9, San Fernando, aftershocks: Wesson, R. L. 00609
1971, February 9, San Fernando, aftershocks, alluvial sites records: Warrick, Richard E. 00618
1971, February 9, San Fernando, aftershocks and San Andreas response: Scholz, Christopher H. 00642
1971, February 9, San Fernando, aftershocks, near-field monitoring: Espinosa, A. F. 00627
1971, February 9, San Fernando, damage: Kachadoorian, Reuben. 00606
1971, February 9, San Fernando, damage, engineering structures: Moran, D. F. 00635

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1971, February 9, San Fernando, damage to oil fields: California Division of Oil and Gas. 00623
1971, February 9, San Fernando, effects on water resources: Waananen, A. O. 00624
1971, February 9, San Fernando, faulting, pattern and movement: Kamb, Barclay. 00612
1971, February 9, San Fernando, faulting, surface breaks: Kahle, J. E. 00744
1971, February 9, San Fernando, fault-plane solution: Dillinger, W. 00628
1971, February 9, San Fernando, fault-plane solutions: Whitcomb, James H. 00610
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1971, February 9, San Fernando, felt area, intensity: Scott, Nina H. 00629
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1971, February 9, San Fernando, general: Grantz, Arthur. 00605
1971, February 9, San Fernando, geologic setting: Oakeshott, Gordon B. 00904
1971, February 9, San Fernando, geologic setting, fault activity: Wentworth, Carl M. 00607
1971, February 9, San Fernando, ground failure: Sharp, Robert V. 00621
1971, February 9, San Fernando, ground-motion observation: King, Kenneth. 00630
1971, February 9, San Fernando, landslides: Morton, Douglas M. 00620
1971, February 9, San Fernando, landslides: Morton, Douglas M. 00789
1971, February 9, San Fernando, landslides, Van Norman Lakes: Youd, T. L. 00643
1971, February 9, San Fernando, magnetic survey, epicentral area: O'Donnell, J. E. 00631
1971, February 9, San Fernando, preearthquake strain accumulation: Whitten, C. A. 00632
1971, February 9, San Fernando, preliminary reports: U.S. Geological Survey. 00604
1971, February 9, San Fernando, Santa Susana thrust movement: Saul, R. B. 00745
1971, February 9, San Fernando, seismologic data, summary: Allen, C. R. 00608
1971, February 9, San Fernando, shattered earth at Sylmar: Nason, Robert D. 00619
1971, February 9, San Fernando, soil movements, foundation failures: Youd, T. L. 00625
1971, February 9, San Fernando, soils, foundations, response: Crandall, L. LeRoy. 00636
1971, February 9, San Fernando, source parameters: Wyss, Max. 00611
1971, February 9, San Fernando, strain meter observations: Berger, Jon. 00645
1971, February 9, San Fernando, strains and tilts: Jungels, Pierre. 00614
1971, February 9, San Fernando, structural lessons: Degenkolb, Henry J. 00626
1971, February 9, San Fernando, surface faulting, effects: Bonilla, M. G. 00613
1971, February 9, San Fernando, surface ruptures, geodetic measurements: Lahr, John C. 00616
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1971, February 9, San Fernando, vertical acceleration, Kagel Canyon: Morrill, B. J. 00634

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1971, February 9, strong-motion data: Maley, R. P. 00633
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Central, subsidence due to ground-water withdrawal, measurement: Riley, Francis S. 00815
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Land subsidence, Wilmington oil field, causes, reduction: Mayuga, M. N. 00806
Land subsidence, Wilmington oil field, compaction, rebound, mechanics: Allen, D. R. 00814
Land use, Contra Costa County, erosion and sedimentation: Brown, F. Raymond. 08388
Landslides, clay mobility, California, Ventura: Kerr, Paul F. 00865
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Subsidence, Delta-Mendota, San Luis Canals, prediction: Prokopovich, N. 00821
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Current research, Santa Barbara Channel, physical, chemical, geologic: Kolpack, Ronald L. 00741
Division of Mines and Geology, organization, mission: California Div. Mines and Geology. 00640
Textbook, guide to geology of the state: Oakeshott, Gordon B. 00785
Geomorphology
Coastal, littoral drift, heavy minerals as indicators: Judge, C. W. 08318
Newport Submarine Canyon, formation mechanism, history: Felix, D. W. 00963
Redondo submarine canyon, sediment transport, mechanism, rate: Beer, R. M. 00964
San Fernando Valley region, landslides, earthquake induced: Morton, Douglas M. 00789
Santa Barbara Channel beaches, transport, flood and oil-spill effects: Kolpack, Ronald L. 00790
Santa Barbara Channel, flood, sediment transport, deposition: Drake, David E. 00742
Geophysical surveys
Cape San Martin, Bryson, Piedras Blancas, San Simeon quads., gravity: Burch, Stephen H. 00732
Coastal and Sierra Nevada, magnetotelluric variations: Schmucker, Ulrich. 08312
San Fernando area, earthquake epicentral area, magnetic: O'Donnell, J. E. 00631
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Santa Clara Valley, artesian head decline, subsidence, ratio: Poland, J. F. 00809
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San Andreas 15-minute quadrangle: Clark, Lorin D. 08182

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Cape San Martin, Bryson, Piedras Blancas, San Simeon quadrangles: Burch, Stephen H. 00732
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Eocene, middle, refrigeration, planktonic Foraminifera: Steineck, P. Lewis. 00967
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Trilobita, ontogeny, dimorphism, n.spp.: Hu, Chung-Hung. 00694
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Economic geology
Peat, genesis, reserves, production, methods: Tibbetts, T. E. 08239
Peat, resources, production cf. world: Tibbetts, T. E. 08238
Petroleum, potential, coal rank as indicator, Atlantic area: Hacquebard, P. A. 08133
Uranium, distribution, exploration, favorable environments: Little, H. W. 08158
Geomorphology
Muskeg, patterned ground, marbloid, development: Korpijaakko, E. O. 08246
Peatlands, permafrost occurrence: Brown, R. J. E. 08258
Geophysical surveys
Ungava Bay-Hudson Strait, Paleozoic-Precambrian contacts: Grant, A. C. 08164
Maps, oil and gas
Western pools: Ball, N. L. 08169
Western pools: Ball, N. L. 08170
Western pools: Ball, N. L. 08171
Paleontology
Foraminifera, Mississippian, Windsor Group, Atlantic Provinces: Globensky, Yvon. 08416
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Precambrian basalts, genesis, trace-element model: Hart, S. R. 08270
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Organic soils, classification: Day, J. H. 08247
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Carbonatite intrusion periodicity, galactic day relation: Macintyre, R. M. 00641
Western, cratonic reactivation, metasomatism, isostasy: Burwash, R. A. 08143
Caribbean region
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Geological research, status, Dec. 1970: Moussa, Mounir T. 08317
Geomorphology
Humid zones, karst features, comparison, processes: Corbel, J. 08201
Caribbean Sea
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Deep Sea Drilling Project, Leg 15, cores: Deep Sea Drilling Project. 00699
Stratigraphy
Cretaceous-Pleistocene, deep-sea cores, biostratigraphy: Deep Sea Drilling Project. 00699
Caves
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Vertebrata, Eocene-Pleistocene, localities, popular guide: Patton, Thomas H. 08363
Geochemistry
Sea water, Sr isotope ratios, glacial effect: Armstrong, Richard Lee. 00938
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West-central, capping lavas: Vitaliano, Charles J. 00758
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Lubbock area, stratigraphy: Brand, John P. 00798
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Point Grenville-Raft River coastal area, Quinault Fm., Foraminifera: Rau, Weldon W. 08374
Central America
Geomorphology
Humid zones, karst features, comparison, processes: Corbel, J. 08201
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Relations, separation of eustatic from isostatic: Morner, Nils-Axel. 00887
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Minnesota, northern peat: Finney, H. R. 08250
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Montmorillonite, swelling, relation to crystal-lattice configuration: Davidtz, John C. 08392
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Stevensite, review, montmorillonite mineral: Rothstein, Joe. 00915
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Collections
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Evaluation of pore space occupied: Morrow, N. R. 00767
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Paleomagnetism
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California's changing landscape, guide to geology of the state: Oakeshott, Gordon B. 00785
Earth science, college level, liberal arts student: Navarra, John Gabriel. 00766
History of the Earth, introduction to historical geology: Kummel, Bernhard. 08401
How to know rocks and minerals, identification keys, elementary: Helfer, Jacques R. 08335
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Bibliography, 1968: U.S. Geological Survey. 00690
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Green River Formation, nitrogenous compounds, mass spectrometry: Simoneit, B. R. 00905
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Elliot Lake area, Quirke Lake Group, faults, clastic intrusions: Robertson, James A. 00706

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Geological Society of America
Penrose Conference, 1970, ultramafic inclusions: Best, Myron G. 00823
Highway problems
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Remote sensing
Natural resources, applications, Alaska 1969: Welch, Robin I. 08224
Rock mechanics
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University of Arizona
Mining and ecology, arid environment, 1970: Peters, W. C. 08299
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Data processing in biology and geology, 1969: Cutbill, J. L. 00746
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